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<b>(21) International Application Number:</b> PCT/US97/19422 <b>(22) International Filing Date:</b> 30 October 1997 (30.10.97)  <b>(30) Priority Data:</b> 60/029,960      31 October 1996 (31.10.96)      US  <b>(71) Applicant (for all designated States except US):</b> HUMAN GENOME SCIENCES, INC. [US/US]; 9410 Key West Avenue, Rockville, MD 20850 (US).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> KUNSCH, Charles, A. [US/US]; 2398B Dunwoody Crossing, Atlanta, GA 30338 (US). CHOI, Gil, H. [KR/US]; 11429 Potomac Oaks Drive, Rockville, MD 20850 (US). JOHNSON, L., Sydnor [US/US]; 13545 Ambassador Drive, Germantown, MD 20874 (US). HROMOCKYJ, Alex [US/US]; 10003 Sidney Road, Silver Spring, MD 20901 (US).  <b>(74) Agents:</b> BROOKES, A., Anders et al.; Human Genome Sciences, Inc., 9410 Key West Avenue, Rockville, MD 20850 (US).	<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i>	
<b>(54) Title:</b> <i>STREPTOCOCCUS PNEUMONIAE</i> ANTIGENS AND VACCINES		
<b>(57) Abstract</b> <p>The present invention relates to novel vaccines for the prevention or attenuation of infection by <i>Streptococcus pneumoniae</i>. The invention further relates to isolated nucleic acid molecules encoding antigenic polypeptides of <i>Streptococcus pneumoniae</i>. Antigenic polypeptides are also provided, as are vectors, host cells and recombinant methods for producing the same. The invention additionally relates to diagnostic methods for detecting <i>Streptococcus</i> nucleic acids, polypeptides and antibodies in a biological sample.</p>		

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## ***Streptococcus pneumoniae* Antigens and Vaccines**

### ***Field of the Invention***

The present invention relates to novel *Streptococcus pneumoniae* antigens for the detection of *Streptococcus* and for the prevention or attenuation of disease caused by *Streptococcus*. The invention further relates to isolated nucleic acid molecules encoding antigenic polypeptides of *S. pneumoniae*. Antigenic polypeptides are also provided, as are vectors, host cells and recombinant methods for producing the same. The invention additionally relates to diagnostic methods for detecting *Streptococcus* gene expression.

### ***Background of the Invention***

*Streptococcus pneumoniae* has been one of the most extensively studied microorganisms since its first isolation in 1881. It was the object of many investigations that led to important scientific discoveries. In 1928, Griffith observed that when heat-killed encapsulated pneumococci and live strains constitutively lacking any capsule were concomitantly injected into mice, the nonencapsulated could be converted into encapsulated pneumococci with the same capsular type as the heat-killed strain. Years later, the nature of this "transforming principle," or carrier of genetic information, was shown to be DNA. (Avery, O.T., *et al.*, *J. Exp. Med.*, 79:137-157 (1944)).

In spite of the vast number of publications on *S. pneumoniae* many questions about its virulence are still unanswered, and this pathogen remains a major causative agent of serious human disease, especially community-acquired pneumonia. (Johnston, R.B., *et al.*, *Rev. Infect. Dis.* 13(Suppl. 6):S509-517 (1991)). In addition, in developing countries, the pneumococcus is responsible for the death of a large number of children under the age of 5 years from pneumococcal pneumonia. The incidence of pneumococcal disease is highest in infants under 2 years of age and in people over 60 years of age. Pneumococci are the second most frequent cause (after *Haemophilus influenzae* type b) of bacterial meningitis and otitis media in children. With the recent introduction of conjugate vaccines for *H. influenzae* type b, pneumococcal meningitis is likely to become increasingly prominent. *S. pneumoniae* is the most important etiologic agent of community-acquired pneumonia in adults and is the second most common cause of bacterial meningitis behind *Neisseria meningitidis*.

The antibiotic generally prescribed to treat *S. pneumoniae* is benzylpenicillin, although resistance to this and to other antibiotics is found occasionally. Pneumococcal resistance to penicillin results from mutations in its

penicillin-binding proteins. In uncomplicated pneumococcal pneumonia caused by a sensitive strain, treatment with penicillin is usually successful unless started too late. Erythromycin or clindamycin can be used to treat pneumonia in patients hypersensitive to penicillin, but resistant strains to these drugs exist. Broad spectrum antibiotics (e.g., the tetracyclines) may also be effective, although tetracycline-resistant strains are not rare. In spite of the availability of antibiotics, the mortality of pneumococcal bacteremia in the last four decades has remained stable between 25 and 29%. (Gillespie, S.H., *et al.*, *J. Med. Microbiol.* 28:237-248 (1989).

*S. pneumoniae* is carried in the upper respiratory tract by many healthy individuals. It has been suggested that attachment of pneumococci is mediated by a disaccharide receptor on fibronectin, present on human pharyngeal epithelial cells. (Anderson, B.J., *et al.*, *J. Immunol.* 142:2464-2468 (1989). The mechanisms by which pneumococci translocate from the nasopharynx to the lung, thereby causing pneumonia, or migrate to the blood, giving rise to bacteremia or septicemia, are poorly understood. (Johnston, R.B., *et al.*, *Rev. Infect. Dis.* 13(Suppl. 6):S509-517 (1991).

Various proteins have been suggested to be involved in the pathogenicity of *S. pneumoniae*, however, only a few of them have actually been confirmed as virulence factors. Pneumococci produce an IgA1 protease that might interfere with host defense at mucosal surfaces. (Kornfield, S.J., *et al.*, *Rev. Inf. Dis.* 3:521-534 (1981). *S. pneumoniae* also produces neuraminidase, an enzyme that may facilitate attachment to epithelial cells by cleaving sialic acid from the host glycolipids and gangliosides. Partially purified neuraminidase was observed to induce meningitis-like symptoms in mice; however, the reliability of this finding has been questioned because the neuraminidase preparations used were probably contaminated with cell wall products. Other pneumococcal proteins besides neuraminidase are involved in the adhesion of pneumococci to epithelial and endothelial cells. These pneumococcal proteins have as yet not been identified. Recently, Cundell *et al.*, reported that peptide permeases can modulate pneumococcal adherence to epithelial and endothelial cells. It was, however, unclear whether these permeases function directly as adhesions or whether they enhance adherence by modulating the expression of pneumococcal adhesions. (DeVelasco, E.A., *et al.*, *Micro. Rev.* 59:591-603 (1995). A better understanding of the virulence factors determining its pathogenicity will need to be developed to cope with the devastating effects of pneumococcal disease in humans.

Ironically, despite the prominent role of *S. pneumoniae* in the discovery of DNA, little is known about the molecular genetics of the organism. The *S. pneumoniae* genome consists of one circular, covalently closed, double-stranded DNA and a collection of so-called variable accessory elements, such as prophages, plasmids, transposons and the like. Most physical characteristics and almost all of the genes of *S. pneumoniae* are unknown. Among the few that have been identified, most have not been physically mapped or characterized in detail. Only a few genes of this organism have been sequenced. (See, for instance current versions of GENBANK and other nucleic acid databases, and references that relate to the genome of *S. pneumoniae* such as those set out elsewhere herein.) Identification of *in vivo*-expressed, and broadly protective, antigens of *S. pneumoniae* has remained elusive.

#### Summary of the Invention

The present invention provides isolated nucleic acid molecules comprising polynucleotides encoding the *S. pneumoniae* polypeptides described in Table 1 and having the amino acid sequences shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226. Thus, one aspect of the invention provides isolated nucleic acid molecules comprising polynucleotides having a nucleotide sequence selected from the group consisting of: (a) a nucleotide sequence encoding any of the amino acid sequences of the polypeptides shown in Table 1; and (b) a nucleotide sequence complementary to any of the nucleotide sequences in (a).

Further embodiments of the invention include isolated nucleic acid molecules that comprise a polynucleotide having a nucleotide sequence at least 90% identical, and more preferably at least 95%, 96%, 97%, 98% or 99% identical, to any of the nucleotide sequences in (a) or (b) above, or a polynucleotide which hybridizes under stringent hybridization conditions to a polynucleotide in (a) or (b) above. This polynucleotide which hybridizes does not hybridize under stringent hybridization conditions to a polynucleotide having a nucleotide sequence consisting of only A residues or of only T residues. Additional nucleic acid embodiments of the invention relate to isolated nucleic acid molecules comprising polynucleotides which encode the amino acid sequences of epitope-bearing portions of an *S. pneumoniae* polypeptide having an amino acid sequence in (a) above.

The present invention also relates to recombinant vectors, which include the isolated nucleic acid molecules of the present invention, and to host cells containing the recombinant vectors, as well as to methods of making such

vectors and host cells and for using these vectors for the production of *S. pneumoniae* polypeptides or peptides by recombinant techniques.

The invention further provides isolated *S. pneumoniae* polypeptides having an amino acid sequence selected from the group consisting of an amino acid sequence of any of the polypeptides described in Table 1.

The polypeptides of the present invention also include polypeptides having an amino acid sequence with at least 70% similarity, and more preferably at least 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% similarity to those described in Table 1, as well as polypeptides having an amino acid sequence at least 70% identical, more preferably at least 75% identical, and still more preferably 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identical to those above; as well as isolated nucleic acid molecules encoding such polypeptides.

The present invention further provides a vaccine, preferably a multi-component vaccine comprising one or more of the *S. pneumoniae* polynucleotides or polypeptides described in Table 1, or fragments thereof, together with a pharmaceutically acceptable diluent, carrier, or excipient, wherein the *S. pneumoniae* polypeptide(s) are present in an amount effective to elicit an immune response to members of the *Streptococcus* genus in an animal. The *S. pneumoniae* polypeptides of the present invention may further be combined with one or more immunogens of one or more other streptococcal or non-streptococcal organisms to produce a multi-component vaccine intended to elicit an immunological response against members of the *Streptococcus* genus and, optionally, one or more non-streptococcal organisms.

The vaccines of the present invention can be administered in a DNA form, e.g., "naked" DNA, wherein the DNA encodes one or more streptococcal polypeptides and, optionally, one or more polypeptides of a non-streptococcal organism. The DNA encoding one or more polypeptides may be constructed such that these polypeptides are expressed fusion proteins.

The vaccines of the present invention may also be administered as a component of a genetically engineered organism. Thus, a genetically engineered organism which expresses one or more *S. pneumoniae* polypeptides may be administered to an animal. For example, such a genetically engineered organism may contain one or more *S. pneumoniae* polypeptides of the present invention intracellularly, on its cell surface, or in its periplasmic space. Further, such a genetically engineered organism may secrete one or more *S. pneumoniae* polypeptides.

The vaccines of the present invention may be co-administered to an animal with an immune system modulator (*e.g.*, CD86 and GM-CSF).

5 The invention also provides a method of inducing an immunological response in an animal to one or more members of the *Streptococcus* genus, preferably one or more isolates of the *S. pneumoniae* genus, comprising administering to the animal a vaccine as described above.

10 The invention further provides a method of inducing a protective immune response in an animal, sufficient to prevent or attenuate an infection by members of the *Streptococcus* genus, preferably at least *S. pneumoniae*, comprising administering to the animal a composition comprising one or more of the polynucleotides or polypeptides described in Table 1, or fragments thereof. Further, these polypeptides, or fragments thereof, may be conjugated to another immunogen and/or administered in admixture with an adjuvant.

15 The invention further relates to antibodies elicited in an animal by the administration of one or more *S. pneumoniae* polypeptides of the present invention and to methods for producing such antibodies.

20 The invention also provides diagnostic methods for detecting the expression of genes of members of the *Streptococcus* genus in an animal. One such method involves assaying for the expression of a gene encoding *S. pneumoniae* peptides in a sample from an animal. This expression may be assayed either directly (*e.g.*, by assaying polypeptide levels using antibodies elicited in response to amino acid sequences described in Table 1) or indirectly (*e.g.*, by assaying for antibodies having specificity for amino acid sequences described in Table 1). An example of such a method involves the use of the  
25 polymerase chain reaction (PCR) to amplify and detect *Streptococcus* nucleic acid sequences.

30 The present invention also relates to nucleic acid probes having all or part of a nucleotide sequence described in Table 1 (shown as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225) which are capable of hybridizing under stringent conditions to *Streptococcus* nucleic acids. The invention further relates to a method of detecting one or more *Streptococcus* nucleic acids in a biological sample obtained from an animal, said one or more nucleic acids encoding *Streptococcus* polypeptides, comprising: (a) contacting the sample with one or more of the above-described nucleic acid probes, under  
35 conditions such that hybridization occurs, and (b) detecting hybridization of said one or more probes to the *Streptococcus* nucleic acid present in the biological sample.

The invention also includes immunoassays, including an immunoassay for detecting *Streptococcus*, preferably at least isolates of the *S. pneumoniae* genus, comprising incubation of a sample (which is suspected of being infected with *Streptococcus*) with a probe antibody directed against an antigen/epitope of *S. pneumoniae*, to be detected under conditions allowing the formation of an antigen-antibody complex; and detecting the antigen-antibody complex which contains the probe antibody. An immunoassay for the detection of antibodies which are directed against a *Streptococcus* antigen comprising the incubation of a sample (containing antibodies from a mammal suspected of being infected with *Streptococcus*) with a probe polypeptide including an epitope of *S. pneumoniae*, under conditions that allow the formation of antigen-antibody complexes which contain the probe epitope containing antigen.

Some aspects of the invention pertaining to kits are those for: investigating samples for the presence of polynucleotides derived from *Streptococcus* which comprise a polynucleotide probe including a nucleotide sequence selected from Table 1 or a fragment thereof of approximately 15 or more nucleotides, in an appropriate container; analyzing the samples for the presence of antibodies directed against a *Streptococcus* antigen made up of a polypeptide which contains a *S. pneumoniae* epitope present in the polypeptide, in a suitable container; and analyzing samples for the presence of *Streptococcus* antigens made up of an anti-*S. pneumoniae* antibody, in a suitable container.

### Detailed Description

The present invention relates to recombinant antigenic *S. pneumoniae* polypeptides and fragments thereof. The invention also relates to methods for using these polypeptides to produce immunological responses and to confer immunological protection to disease caused by members of the genus *Streptococcus*, at least isolates of the *S. pneumoniae* genus. The invention further relates to nucleic acid sequences which encode antigenic *S. pneumoniae* polypeptides and to methods for detecting *S. pneumoniae* nucleic acids and polypeptides in biological samples. The invention also relates to *S. pneumoniae*-specific antibodies and methods for detecting such antibodies produced in a host animal.

### Definitions

The following definitions are provided to clarify the subject matter which the inventors consider to be the present invention.



As used herein, the phrase "pathogenic agent" means an agent which causes a disease state or affliction in an animal. Included within this definition, for examples, are bacteria, protozoans, fungi, viruses and metazoan parasites which either produce a disease state or render an animal infected with such an organism susceptible to a disease state (e.g., a secondary infection). Further included are species and strains of the genus *Streptococcus* which produce disease states in animals.

As used herein, the term "organism" means any living biological system, including viruses, regardless of whether it is a pathogenic agent.

As used herein, the term "*Streptococcus*" means any species or strain of bacteria which is members of the genus *Streptococcus*. Such species and strains are known to those of skill in the art, and include those that are pathogenic and those that are not.

As used herein, the phrase "one or more *S. pneumoniae* polypeptides of the present invention" means polypeptides comprising the amino acid sequence of one or more of the *S. pneumoniae* polypeptides described in Table 1 and disclosed as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226. These polypeptides may be expressed as fusion proteins wherein the *S. pneumoniae* polypeptides of the present invention are linked to additional amino acid sequences which may be of streptococcal or non-streptococcal origin. This phrase further includes polypeptide comprising fragments of the *S. pneumoniae* polypeptides of the present invention.

Additional definitions are provided throughout the specification.

#### ***Explanation of Table 1***

Table 1, below, provides information describing 113 open reading frames (ORFs) which encode potentially antigenic polypeptides of *S. pneumoniae* of the present invention. The table lists the ORF identifier which consists of the letters SP, which denote *S. pneumoniae*, followed immediately by a three digit numeric code, which arbitrarily number the potentially antigenic polypeptides of *S. pneumoniae* of the present invention and the nucleotide or amino acid sequence of each ORF and encoded polypeptide. The table further correlates the ORF identifier with a sequence identification number (SEQ ID NO:). The actual nucleotide or amino acid sequence of each ORF identifier is also shown in the Sequence Listing under the corresponding SEQ ID NO.

Thus, for example, the designation "SP126" refers to both the nucleotide and amino acid sequences of *S. pneumoniae* polypeptide number 126 of the present invention. Further, "SP126" correlates with the nucleotide

sequence shown as SEQ ID NO:223 and with the amino acid sequence shown as SEQ ID NO:224 as is described in Table 1.

The open reading frame within each "ORF" begins with the second nucleotide shown. Thus, the first codon for each nucleotide sequence shown is bases 2-4, the second 5-7, the third 8-10, and so on.

### ***Explanation of Table 2***

Table 2 lists the antigenic epitopes present in each of the *S. pneumoniae* polypeptides described in Table 1 as predicted by the inventors. Each *S. pneumoniae* polypeptide shown in Table 1 has one or more antigenic epitopes described in Table 2. It will be appreciated that depending on the analytical criteria used to predict antigenic determinants, the exact address of the determinant may vary slightly. The exact location of the antigenic determinant may shift by about 1 to 5 residues, more likely 1 to 2 residues, depending on the criteria used. Thus, the first antigenic determinant described in Table 2, "Lys-1 to Ile-10" of SP001, represents a peptide comprising the lysine at position 1 in SEQ ID NO:2 through and including the isoleucine at position 10 in SEQ ID NO:2, but may include more or fewer residues than those 10. It will also be appreciated that, generally speaking, amino acids can be added to either terminus of a peptide or polypeptide containing an antigenic epitope without affecting its activity, whereas removing residues from a peptide or polypeptide containing only the antigenic determinant is much more likely to destroy activity. It will be appreciated that the residues and locations shown described in Table 2 correspond to the amino acid sequences for each ORF shown in Table 1 and in the Sequence Listing.

### ***Explanation of Table 3***

Table 3 shows PCR primers designed by the inventors for the amplification of polynucleotides encoding polypeptides of the present invention according to the method of Example 1. PCR primer design is routine in the art and those shown in Table 3 are provided merely for the convenience of the skilled artisan. It will be appreciated that others can be used with equal success.

For each primer, the table lists the corresponding ORF designation from Table 1 followed by either an "A" or a "B". The "A" primers are the 5' primers and the "B" primers 3'. A restriction enzyme site was built into each primer to allow ease of cloning. The restriction enzyme which will recognize and cleave a sequence within each primer is shown in Table 3, as well, under the heading

"RE" for restriction enzyme. Finally the sequence identifier is shown in Table 3 for each primer for easy correlation with the Sequence Listing.

***Selection of Nucleic Acid Sequences Encoding Antigenic S. pneumoniae Polypeptides***

The present invention provides a select number of ORFs from those presented in the fragments of the *S. pneumoniae* genome which may prove useful for the generation of a protective immune response. The sequenced *S. pneumoniae* genomic DNA was obtained from a sub-cultured isolate of *S. pneumoniae* Strain 7/87 14.8.91, which has been deposited at the American Type Culture Collection, as a convenience to those of skill in the art. The *S. pneumoniae* isolate was deposited on October 10, 1996 at the ATCC, 12301 Park Lawn Drive, Rockville, Maryland 20852, and given accession number 55840. A genomic library constructed from DNA isolated from the *S. pneumoniae* isolate was also deposited at the ATCC on October 11, 1996 and given ATCC Deposit No. 97755. A more complete listing of the sequence obtained from the *S. pneumoniae* genome may be found in co-pending U.S. Provisional Application Serial No. 60/029,960, filed 10/31/96, incorporated herein by reference in its entirety. Some ORFs contained in the subset of fragments of the *S. pneumoniae* genome disclosed herein were derived through the use of a number of screening criteria detailed below.

The selected ORFs do not consist of complete ORFs. Although a polypeptide representing a complete ORF may be the closest approximation of a protein native to an organism, it is not always preferred to express a complete ORF in a heterologous system. It may be challenging to express and purify a highly hydrophobic protein by common laboratory methods. Thus, the polypeptide vaccine candidates described herein may have been modified slightly to simplify the production of recombinant protein. For example, nucleotide sequences which encode highly hydrophobic domains, such as those found at the amino terminal signal sequence, have been excluded from some constructs used for *in vitro* expression of the polypeptides. Furthermore, any highly hydrophobic amino acid sequences occurring at the carboxy terminus have also been excluded from the recombinant expression constructs. Thus, in one embodiment, a polypeptide which represents a truncated or modified ORF may be used as an antigen.

While numerous methods are known in the art for selecting potentially immunogenic polypeptides, many of the ORFs disclosed herein were selected

on the basis of screening all theoretical *S. pneumoniae* ORFs for several aspects of potential immunogenicity. One set of selection criteria are as follows:

5 1. *Type I signal sequence*: An amino terminal type I signal sequence generally directs a nascent protein across the plasma and outer membranes to the exterior of the bacterial cell. Experimental evidence obtained from studies with *Escherichia coli* suggests that the typical type I signal sequence consists of the following biochemical and physical attributes (Izard, J. W. and Kendall, D. A. *Mol. Microbiol.* 13:765-773 (1994)). The length of the type I signal sequence is approximately 15 to 25 primarily hydrophobic amino acid residues with a net  
10 positive charge in the extreme amino terminus. In addition, the central region of the signal sequence adopts an alpha-helical conformation in a hydrophobic environment. Finally, the region surrounding the actual site of cleavage is ideally six residues long, with small side-chain amino acids in the -1 and -3 positions.

15 2. *Type IV signal sequence*: The type IV signal sequence is an example of the several types of functional signal sequences which exist in addition to the type I signal sequence detailed above. Although functionally related, the type IV signal sequence possesses a unique set of biochemical and physical attributes (Strom, M. S. and Lory, S., *J. Bacteriol.* 174:7345-7351 (1992)). These are  
20 typically six to eight amino acids with a net basic charge followed by an additional sixteen to thirty primarily hydrophobic residues. The cleavage site of a type IV signal sequence is typically after the initial six to eight amino acids at the extreme amino terminus. In addition, type IV signal sequences generally contain a phenylalanine residue at the +1 site relative to the cleavage site.

25 3. *Lipoprotein*: Studies of the cleavage sites of twenty-six bacterial lipoprotein precursors has allowed the definition of a consensus amino acid sequence for lipoprotein cleavage. Nearly three-fourths of the bacterial lipoprotein precursors examined contained the sequence L-(A,S)-(G,A)-C at positions -3 to +1, relative to the point of cleavage (Hayashi, S. and Wu, H. C., *J. Bioenerg. Biomembr.* 22:451-471 (1990)).  
30

35 4. *LPXTG motif*: It has been experimentally determined that most anchored proteins found on the surface of gram-positive bacteria possess a highly conserved carboxy terminal sequence. More than fifty such proteins from organisms such as *S. pyogenes*, *S. mutans*, *E. faecalis*, *S. pneumoniae*, and others, have been identified based on their extracellular location and carboxy terminal amino acid sequence (Fischetti, V. A., *ASM News* 62:405-410 (1996)). The conserved region consists of six charged amino acids at the extreme carboxy terminus coupled to 15-20 hydrophobic amino acids

presumed to function as a transmembrane domain. Immediately adjacent to the transmembrane domain is a six amino acid sequence conserved in nearly all proteins examined. The amino acid sequence of this region is L-P-X-T-G-X, where X is any amino acid.

5           An algorithm for selecting antigenic and immunogenic *S. pneumoniae* polypeptides including the foregoing criteria was developed. Use of the algorithm by the inventors to select immunologically useful *S. pneumoniae* polypeptides resulted in the selection of a number of the disclosed ORFs. Polypeptides comprising the polypeptides identified in this group may be  
10           produced by techniques standard in the art and as further described herein.

### *Nucleic Acid Molecules*

          The present invention provides isolated nucleic acid molecules comprising polynucleotides encoding the *S. pneumoniae* polypeptides having  
15           the amino acid sequences described in Table 1 and shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226, which were determined by sequencing the genome of *S. pneumoniae* and selected as putative immunogens.

          Unless otherwise indicated, all nucleotide sequences determined by  
20           sequencing a DNA molecule herein were determined using an automated DNA sequencer (such as the Model 373 from Applied Biosystems, Inc.), and all amino acid sequences of polypeptides encoded by DNA molecules determined herein were predicted by translation of DNA sequences determined as above. Therefore, as is known in the art for any DNA sequence determined by this  
25           automated approach, any nucleotide sequence determined herein may contain some errors. Nucleotide sequences determined by automation are typically at least about 90% identical, more typically at least about 95% to at least about 99.9% identical to the actual nucleotide sequence of the sequenced DNA molecule. The actual sequence can be more precisely determined by other  
30           approaches including manual DNA sequencing methods well known in the art. As is also known in the art, a single insertion or deletion in a determined nucleotide sequence compared to the actual sequence will cause a frame shift in translation of the nucleotide sequence such that the predicted amino acid  
35           sequence encoded by a determined nucleotide sequence will be completely different from the amino acid sequence actually encoded by the sequenced DNA molecule, beginning at the point of such an insertion or deletion.

          Unless otherwise indicated, each "nucleotide sequence" set forth herein is presented as a sequence of deoxyribonucleotides (abbreviated A, G, C and

T). However, by "nucleotide sequence" of a nucleic acid molecule or polynucleotide is intended, for a DNA molecule or polynucleotide, a sequence of deoxyribonucleotides, and for an RNA molecule or polynucleotide, the corresponding sequence of ribonucleotides (A, G, C and U), where each thymidine deoxyribonucleotide (T) in the specified deoxyribonucleotide sequence is replaced by the ribonucleotide uridine (U). For instance, reference to an RNA molecule having a sequence described in Table 1 set forth using deoxyribonucleotide abbreviations is intended to indicate an RNA molecule having a sequence in which each deoxyribonucleotide A, G or C described in Table 1 has been replaced by the corresponding ribonucleotide A, G or C, and each deoxyribonucleotide T has been replaced by a ribonucleotide U.

Nucleic acid molecules of the present invention may be in the form of RNA, such as mRNA, or in the form of DNA, including, for instance, cDNA and genomic DNA obtained by cloning or produced synthetically. The DNA may be double-stranded or single-stranded. Single-stranded DNA or RNA may be the coding strand, also known as the sense strand, or it may be the non-coding strand, also referred to as the anti-sense strand.

By "isolated" nucleic acid molecule(s) is intended a nucleic acid molecule, DNA or RNA, which has been removed from its native environment. For example, recombinant DNA molecules contained in a vector are considered isolated for the purposes of the present invention. Further examples of isolated DNA molecules include recombinant DNA molecules maintained in heterologous host cells or purified (partially or substantially) DNA molecules in solution. Isolated RNA molecules include *in vivo* or *in vitro* RNA transcripts of the DNA molecules of the present invention. Isolated nucleic acid molecules according to the present invention further include such molecules produced synthetically.

Isolated nucleic acid molecules of the present invention include DNA molecules comprising a nucleotide sequence described in Table 1 and shown as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225; DNA molecules comprising the coding sequences for the polypeptides described in Table 1 and shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226; and DNA molecules which comprise sequences substantially different from those described above but which, due to the degeneracy of the genetic code, still encode the *S. pneumoniae* polypeptides described in Table 1. Of course, the genetic code is well known in the art. Thus, it would be routine for one skilled in the art to generate such degenerate variants.

The invention also provides nucleic acid molecules having sequences complementary to any one of those described in Table 1. Such isolated molecules, particularly DNA molecules, are useful as probes for detecting expression of *Streptococcal* genes, for instance, by Northern blot analysis or the polymerase chain reaction (PCR).

The present invention is further directed to fragments of the isolated nucleic acid molecules described herein. By a fragment of an isolated nucleic acid molecule having a nucleotide sequence described in Table 1, is intended fragments at least about 15 nt, and more preferably at least about 17 nt, still more preferably at least about 20 nt, and even more preferably, at least about 25 nt in length which are useful as diagnostic probes and primers as discussed herein. Of course, larger fragments 50-100 nt in length are also useful according to the present invention as are fragments corresponding to most, if not all, of a nucleotide sequence described in Table 1. By a fragment at least 20 nt in length, for example, is intended fragments which include 20 or more contiguous bases of a nucleotide sequence as described in Table 1. Since the nucleotide sequences identified in Table 1 are provided as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225, generating such DNA fragments would be routine to the skilled artisan. For example, such fragments could be generated synthetically.

Preferred nucleic acid fragments of the present invention also include nucleic acid molecules comprising nucleotide sequences encoding epitope-bearing portions of the *S. pneumoniae* polypeptides identified in Table 1. Such nucleic acid fragments of the present invention include, for example, nucleotide sequences encoding polypeptide fragments comprising from about the amino terminal residue to about the carboxy terminal residue of each fragment shown in Table 2. The above referred to polypeptide fragments are antigenic regions of the *S. pneumoniae* polypeptides identified in Table 1.

In another aspect, the invention provides isolated nucleic acid molecules comprising polynucleotides which hybridize under stringent hybridization conditions to a portion of a polynucleotide in a nucleic acid molecule of the invention described above, for instance, a nucleic acid sequence identified in Table 1. By "stringent hybridization conditions" is intended overnight incubation at 42°C in a solution comprising: 50% formamide, 5x SSC (150 mM NaCl, 15 mM trisodium citrate), 50 mM sodium phosphate (pH 7.6), 5x Denhardt's solution, 10% dextran sulfate, and 20 g/ml denatured, sheared salmon sperm DNA, followed by washing the filters in 0.1x SSC at about 65°C.

By polynucleotides which hybridize to a "portion" of a polynucleotide is intended polynucleotides (either DNA or RNA) which hybridize to at least about 15 nucleotides (nt), and more preferably at least about 17 nt, still more preferably at least about 20 nt, and even more preferably about 25-70 nt of the reference polynucleotide. These are useful as diagnostic probes and primers as discussed above and in more detail below.

Of course, polynucleotides hybridizing to a larger portion of the reference polynucleotide, for instance, a portion 50-100 nt in length, or even to the entire length of the reference polynucleotide, are also useful as probes according to the present invention, as are polynucleotides corresponding to most, if not all, of a nucleotide sequence as identified in Table 1. By a portion of a polynucleotide of "at least 20 nt in length," for example, is intended 20 or more contiguous nucleotides from the nucleotide sequence of the reference polynucleotide (e.g., a nucleotide sequences as described in Table 1). As noted above, such portions are useful diagnostically either as probes according to conventional DNA hybridization techniques or as primers for amplification of a target sequence by PCR, as described in the literature (for instance, in *Molecular Cloning, A Laboratory Manual*, 2nd. edition, Sambrook, J., Fritsch, E. F. and Maniatis, T., eds., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989), the entire disclosure of which is hereby incorporated herein by reference).

Since nucleic acid sequences encoding the *S. pneumoniae* polypeptides of the present invention are identified in Table 1 and provided as SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, and so on through SEQ ID NO:225, generating polynucleotides which hybridize to portions of these sequences would be routine to the skilled artisan. For example, the hybridizing polynucleotides of the present invention could be generated synthetically according to known techniques.

As indicated, nucleic acid molecules of the present invention which encode *S. pneumoniae* polypeptides of the present invention may include, but are not limited to those encoding the amino acid sequences of the polypeptides by themselves; and additional coding sequences which code for additional amino acids, such as those which provide additional functionalities. Thus, the sequences encoding these polypeptides may be fused to a marker sequence, such as a sequence encoding a peptide which facilitates purification of the fused polypeptide. In certain preferred embodiments of this aspect of the invention, the marker amino acid sequence is a hexa-histidine peptide, such as the tag provided in a pQE vector (Qiagen, Inc.), among others, many of which are



commercially available. As described by Gentz and colleagues (*Proc. Natl. Acad. Sci. USA* 86:821-824 (1989)), for instance, hexa-histidine provides for convenient purification of the resulting fusion protein.

Thus, the present invention also includes genetic fusions wherein the *S. pneumoniae* nucleic acid sequences coding sequences identified in Table 1 are linked to additional nucleic acid sequences to produce fusion proteins. These fusion proteins may include epitopes of streptococcal or non-streptococcal origin designed to produce proteins having enhanced immunogenicity. Further, the fusion proteins of the present invention may contain antigenic determinants known to provide helper T-cell stimulation, peptides encoding sites for post-translational modifications which enhance immunogenicity (*e.g.*, acylation), peptides which facilitate purification (*e.g.*, histidine "tag"), or amino acid sequences which target the fusion protein to a desired location (*e.g.*, a heterologous leader sequence).

In all cases of bacterial expression, an N-terminal methionine residues is added. In many cases, however, the N-terminal methionine residues is cleaved off post-translationally. Thus, the invention includes polypeptides shown in Table 1 with, and without an N-terminal methionine.

The present invention thus includes nucleic acid molecules and sequences which encode fusion proteins comprising one or more *S. pneumoniae* polypeptides of the present invention fused to an amino acid sequence which allows for post-translational modification to enhance immunogenicity. This post-translational modification may occur either *in vitro* or when the fusion protein is expressed *in vivo* in a host cell. An example of such a modification is the introduction of an amino acid sequence which results in the attachment of a lipid moiety.

Thus, as indicated above, the present invention includes genetic fusions wherein a *S. pneumoniae* nucleic acid sequence identified in Table 1 is linked to a nucleotide sequence encoding another amino acid sequence. These other amino acid sequences may be of streptococcal origin (*e.g.*, another sequence selected from Table 1) or non-streptococcal origin.

The present invention further relates to variants of the nucleic acid molecules of the present invention, which encode portions, analogs or derivatives of the *S. pneumoniae* polypeptides described in Table 1. Variants may occur naturally, such as a natural allelic variant. By an "allelic variant" is intended one of several alternate forms of a gene occupying a given locus on a chromosome of an organism (*Genes II*, Lewin, B., ed., John Wiley & Sons,

New York (1985)). Non-naturally occurring variants may be produced using art-known mutagenesis techniques.

Such variants include those produced by nucleotide substitutions, deletions or additions. The substitutions, deletions or additions may involve one or more nucleotides. These variants may be altered in coding regions, non-coding regions, or both. Alterations in the coding regions may produce conservative or non-conservative amino acid substitutions, deletions or additions. Especially preferred among these are silent substitutions, additions and deletions, which do not alter the properties and activities of the *S. pneumoniae* polypeptides disclosed herein or portions thereof. Silent substitution are most likely to be made in non-epitopic regions. Guidance regarding those regions containing epitopes is provided herein, for example, in Table 2. Also especially preferred in this regard are conservative substitutions.

Further embodiments of the invention include isolated nucleic acid molecules comprising a polynucleotide having a nucleotide sequence at least 90% identical, and more preferably at least 95%, 96%, 97%, 98% or 99% identical to: (a) a nucleotide sequence encoding any of the amino acid sequences of the polypeptides identified in Table 1; and (b) a nucleotide sequence complementary to any of the nucleotide sequences in (a) above.

By a polynucleotide having a nucleotide sequence at least, for example, 95% "identical" to a reference nucleotide sequence encoding a *S. pneumoniae* polypeptide described in Table 1, is intended that the nucleotide sequence of the polynucleotide is identical to the reference sequence except that the polynucleotide sequence may include up to five point mutations per each 100 nucleotides of the reference nucleotide sequence encoding the subject *S. pneumoniae* polypeptide. In other words, to obtain a polynucleotide having a nucleotide sequence at least 95% identical to a reference nucleotide sequence, up to 5% of the nucleotides in the reference sequence may be deleted or substituted with another nucleotide, or a number of nucleotides up to 5% of the total nucleotides in the reference sequence may be inserted into the reference sequence. These mutations of the reference sequence may occur at the 5' or 3' terminal positions of the reference nucleotide sequence or anywhere between those terminal positions, interspersed either individually among nucleotides in the reference sequence or in one or more contiguous groups within the reference sequence.

Certain nucleotides within some of the nucleic acid sequences shown in Table 1 were ambiguous upon sequencing. Completely unknown sequences are shown as an "N". Other unresolved nucleotides are known to be either a

purine, shown as "R", or a pyrimidine, shown as "Y". Accordingly, when determining identity between two nucleotide sequences, identity is met where any nucleotide, including an "R", "Y" or "N", is found in a test sequence and at the corresponding position in the reference sequence (from Table 1). Likewise, an A, G or "R" in a test sequence is identical to an "R" in the reference sequence; and a T, C or "Y" in a test sequence is identical to a "Y" in the reference sequence.

As a practical matter, whether any particular nucleic acid molecule is at least 90%, 95%, 96%, 97%, 98% or 99% identical to, for instance, a nucleotide sequence described in Table 1 can be determined conventionally using known computer programs such as the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711). Bestfit uses the local homology algorithm of Smith and Waterman (*Advances in Applied Mathematics* 2:482-489 (1981)), to find the best segment of homology between two sequences. When using Bestfit or any other sequence alignment program to determine whether a particular sequence is, for instance, 95% identical to a reference sequence according to the present invention, the parameters are set, of course, such that the percentage of identity is calculated over the full length of the reference nucleotide sequence and that gaps in homology of up to 5% of the total number of nucleotides in the reference sequence are allowed.

The present application is directed to nucleic acid molecules at least 90%, 95%, 96%, 97%, 98% or 99% identical to a nucleic acid sequences described in Table 1. One of skill in the art would still know how to use the nucleic acid molecule, for instance, as a hybridization probe or a polymerase chain reaction (PCR) primer. Uses of the nucleic acid molecules of the present invention include, *inter alia*, (1) isolating *Streptococcal* genes or allelic variants thereof from either a genomic or cDNA library and (2) Northern Blot or PCR analysis for detecting *Streptococcal* mRNA expression.

Of course, due to the degeneracy of the genetic code, one of ordinary skill in the art will immediately recognize that a large number of nucleic acid molecules having a sequence at least 90%, 95%, 96%, 97%, 98%, or 99% identical to a nucleic acid sequence identified in Table 1 will encode the same polypeptide. In fact, since degenerate variants of these nucleotide sequences all encode the same polypeptide, this will be clear to the skilled artisan even without performing the above described comparison assay.

It will be further recognized in the art that, for such nucleic acid molecules that are not degenerate variants, a reasonable number will also encode

proteins having antigenic epitopes of the *S. pneumoniae* polypeptides of the present invention. This is because the skilled artisan is fully aware of amino acid substitutions that are either less likely or not likely to significantly effect the antigenicity of a polypeptide (*e.g.*, replacement of an amino acid in a region which is not believed to form an antigenic epitope). For example, since antigenic epitopes have been identified which contain as few as six amino acids (see Harlow, *et al.*, *Antibodies: A Laboratory Manual, 2nd Ed.*; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York (1988), page 76), in instances where a polypeptide has multiple antigenic epitopes the alteration of several amino acid residues would often not be expected to eliminate all of the antigenic epitopes of that polypeptide. This is especially so when the alterations are in regions believed to not constitute antigenic epitopes.

### *Vectors and Host Cells*

The present invention also relates to vectors which include the isolated DNA molecules of the present invention, host cells which are genetically engineered with the recombinant vectors, and the production of *S. pneumoniae* polypeptides or fragments thereof by recombinant techniques.

Recombinant constructs may be introduced into host cells using well known techniques such as infection, transduction, transfection, transvection, electroporation and transformation. The vector may be, for example, a phage, plasmid, viral or retroviral vector. Retroviral vectors may be replication competent or replication defective. In the latter case, viral propagation generally will occur only in complementing host cells.

The polynucleotides may be joined to a vector containing a selectable marker for propagation in a host. Generally, a plasmid vector is introduced in a precipitate, such as a calcium phosphate precipitate, or in a complex with a charged lipid. If the vector is a virus, it may be packaged *in vitro* using an appropriate packaging cell line and then transduced into host cells.

Preferred are vectors comprising *cis*-acting control regions to the polynucleotide of interest. Appropriate *trans*-acting factors may be supplied by the host, supplied by a complementing vector or supplied by the vector itself upon introduction into the host.

In certain preferred embodiments in this regard, the vectors provide for specific expression, which may be inducible and/or cell type-specific. Particularly preferred among such vectors are those inducible by environmental factors that are easy to manipulate, such as temperature and nutrient additives.

Expression vectors useful in the present invention include chromosomal-, episomal- and virus-derived vectors, *e.g.*, vectors derived from bacterial plasmids, bacteriophage, yeast episomes, yeast chromosomal elements, viruses such as baculoviruses, papova viruses, vaccinia viruses, adenoviruses, fowl pox viruses, pseudorabies viruses and retroviruses, and vectors derived from combinations thereof, such as cosmids and phagemids.

The DNA insert should be operatively linked to an appropriate promoter, such as the phage lambda PL promoter, the *E. coli lac*, *trp* and *tac* promoters, the SV40 early and late promoters and promoters of retroviral LTRs, to name a few. Other suitable promoters will be known to the skilled artisan. The expression constructs will further contain sites for transcription initiation, termination and, in the transcribed region, a ribosome binding site for translation. The coding portion of the mature transcripts expressed by the constructs will preferably include a translation initiating site at the beginning and a termination codon (UAA, UGA or UAG) appropriately positioned at the end of the polypeptide to be translated.

As indicated, the expression vectors will preferably include at least one selectable marker. Such markers include dihydrofolate reductase or neomycin resistance for eukaryotic cell culture and tetracycline or ampicillin resistance genes for culturing in *E. coli* and other bacteria. Representative examples of appropriate hosts include, but are not limited to, bacterial cells, such as *E. coli*, *Streptomyces* and *Salmonella typhimurium* cells; fungal cells, such as yeast cells; insect cells such as *Drosophila* S2 and *Spodoptera* Sf9 cells; animal cells such as CHO, COS and Bowes melanoma cells; and plant cells. Appropriate culture mediums and conditions for the above-described host cells are known in the art.

Among vectors preferred for use in bacteria include pQE70, pQE60 and pQE-9, available from Qiagen; pBS vectors, Phagescript vectors, Bluescript vectors, pNH8A, pNH16a, pNH18A, pNH46A available from Stratagene; pET series of vectors available from Novagen; and ptc99a, pKK223-3, pKK233-3, pDR540, pRIT5 available from Pharmacia. Among preferred eukaryotic vectors are pWLNEO, pSV2CAT, pOG44, pXT1 and pSG available from Stratagene; and pSVK3, pBPV, pMSG and pSVL available from Pharmacia. Other suitable vectors will be readily apparent to the skilled artisan.

Among known bacterial promoters suitable for use in the present invention include the *E. coli lacI* and *lacZ* promoters, the T3 and T7 promoters, the *gpt* promoter, the lambda PR and PL promoters and the *trp* promoter. Suitable eukaryotic promoters include the CMV immediate early promoter, the

HSV thymidine kinase promoter, the early and late SV40 promoters, the promoters of retroviral LTRs, such as those of the Rous sarcoma virus (RSV), and metallothionein promoters, such as the mouse metallothionein-I promoter.

5 Introduction of the construct into the host cell can be effected by calcium phosphate transfection, DEAE-dextran mediated transfection, cationic lipid-mediated transfection, electroporation, transduction, infection or other methods. Such methods are described in many standard laboratory manuals (for example, Davis, *et al.*, *Basic Methods In Molecular Biology* (1986)).

10 Transcription of DNA encoding the polypeptides of the present invention by higher eukaryotes may be increased by inserting an enhancer sequence into the vector. Enhancers are *cis*-acting elements of DNA, usually about from 10 to 300 bp that act to increase transcriptional activity of a promoter in a given host cell-type. Examples of enhancers include the SV40 enhancer, which is located on the late side of the replication origin at bp 100 to 270, the  
15 cytomegalovirus early promoter enhancer, the polyoma enhancer on the late side of the replication origin, and adenovirus enhancers.

For secretion of the translated polypeptide into the lumen of the endoplasmic reticulum, into the periplasmic space or into the extracellular environment, appropriate secretion signals may be incorporated into the  
20 expressed polypeptide. The signals may be endogenous to the polypeptide or they may be heterologous signals.

The polypeptide may be expressed in a modified form, such as a fusion protein, and may include not only secretion signals, but also additional heterologous functional regions. For instance, a region of additional amino  
25 acids, particularly charged amino acids, may be added to the N-terminus of the polypeptide to improve stability and persistence in the host cell, during purification, or during subsequent handling and storage. Also, peptide moieties may be added to the polypeptide to facilitate purification. Such regions may be removed prior to final preparation of the polypeptide. The addition of peptide  
30 moieties to polypeptides to engender secretion or excretion, to improve stability and to facilitate purification, among others, are familiar and routine techniques in the art. A preferred fusion protein comprises a heterologous region from immunoglobulin that is useful to solubilize proteins. For example, EP-A-O 464 533 (Canadian counterpart 2045869) discloses fusion proteins comprising  
35 various portions of constant region of immunoglobulin molecules together with another human protein or part thereof. In many cases, the Fc part in a fusion protein is thoroughly advantageous for use in therapy and diagnosis and thus results, for example, in improved pharmacokinetic properties (EP-A 0232 262).

On the other hand, for some uses it would be desirable to be able to delete the Fc part after the fusion protein has been expressed, detected and purified in the advantageous manner described. This is the case when Fc portion proves to be a hindrance to use in therapy and diagnosis, for example when the fusion protein is to be used as antigen for immunizations. In drug discovery, for example, human proteins, such as, hIL-5-receptor has been fused with Fc portions for the purpose of high-throughput screening assays to identify antagonists of hIL-5. See Bennett, D. *et al.*, *J. Molec. Recogn.* 8:52-58 (1995) and Johanson, K. *et al.*, *J. Biol. Chem.* 270 (16):9459-9471 (1995).

The *S. pneumoniae* polypeptides can be recovered and purified from recombinant cell cultures by well-known methods including ammonium sulfate or ethanol precipitation, acid extraction, anion or cation exchange chromatography, phosphocellulose chromatography, hydrophobic interaction chromatography, affinity chromatography, hydroxylapatite chromatography, lectin chromatography and high performance liquid chromatography ("HPLC") is employed for purification. Polypeptides of the present invention include naturally purified products, products of chemical synthetic procedures, and products produced by recombinant techniques from a prokaryotic or eukaryotic host, including, for example, bacterial, yeast, higher plant, insect and mammalian cells.

#### ***Polypeptides and Fragments***

The invention further provides isolated polypeptides having the amino acid sequences described in Table 1, and shown as SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, and so on through SEQ ID NO:226, and peptides or polypeptides comprising portions of the above polypeptides. The terms "peptide" and "oligopeptide" are considered synonymous (as is commonly recognized) and each term can be used interchangeably as the context requires to indicate a chain of at least two amino acids coupled by peptidyl linkages. The word "polypeptide" is used herein for chains containing more than ten amino acid residues. All oligopeptide and polypeptide formulas or sequences herein are written from left to right and in the direction from amino terminus to carboxy terminus.

Some amino acid sequences of the *S. pneumoniae* polypeptides described in Table 1 can be varied without significantly effecting the antigenicity of the polypeptides. If such differences in sequence are contemplated, it should be remembered that there will be critical areas on the polypeptide which determine antigenicity. In general, it is possible to replace residues which do

not form part of an antigenic epitope without significantly effecting the antigenicity of a polypeptide. Guidance for such alterations is given in Table 2 wherein epitopes for each polypeptide is delineated.

5 The polypeptides of the present invention are preferably provided in an isolated form. By "isolated polypeptide" is intended a polypeptide removed from its native environment. Thus, a polypeptide produced and/or contained within a recombinant host cell is considered isolated for purposes of the present invention. Also intended as an "isolated polypeptide" is a polypeptide that has been purified, partially or substantially, from a recombinant host cell. For  
10 example, recombinantly produced versions of the *S. pneumoniae* polypeptides described in Table 1 can be substantially purified by the one-step method described by Smith and Johnson (*Gene* 67:31-40 (1988)).

The polypeptides of the present invention include: (a) an amino acid sequence of any of the polypeptides described in Table 1; and (b) an amino acid  
15 sequence of an epitope-bearing portion of any one of the polypeptides of (a); as well as polypeptides with at least 70% similarity, and more preferably at least 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% similarity to those described in (a) or (b) above, as well as polypeptides having an amino acid sequence at least 70% identical, more preferably at least 75% identical, and still  
20 more preferably 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identical to those above.

By "% similarity" for two polypeptides is intended a similarity score produced by comparing the amino acid sequences of the two polypeptides using the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for  
25 Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711) and the default settings for determining similarity. Bestfit uses the local homology algorithm of Smith and Waterman (*Advances in Applied Mathematics* 2:482-489 (1981)) to find the best segment of similarity between two sequences.

30 By a polypeptide having an amino acid sequence at least, for example, 95% "identical" to a reference amino acid sequence of a *S. pneumoniae* polypeptide is intended that the amino acid sequence of the polypeptide is identical to the reference sequence except that the polypeptide sequence may include up to five amino acid alterations per each 100 amino acids of the  
35 reference amino acid sequence. In other words, to obtain a polypeptide having an amino acid sequence at least 95% identical to a reference amino acid sequence, up to 5% of the amino acid residues in the reference sequence may be deleted or substituted with another amino acid, or a number of amino acids up to



5% of the total amino acid residues in the reference sequence may be inserted into the reference sequence. These alterations of the reference sequence may occur at the amino or carboxy terminal positions of the reference amino acid sequence or anywhere between those terminal positions, interspersed either individually among residues in the reference sequence or in one or more contiguous groups within the reference sequence.

The amino acid sequences shown in Table 1 may have on or more "X" residues. "X" represents unknown. Thus, for purposes of defining identity, if any amino acid is present at the same position in a reference amino acid sequence (shown in Table 1) where an X is shown, the two sequences are identical at that position.

As a practical matter, whether any particular polypeptide is at least 70%, 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identical to, for instance, an amino acid sequence shown in Table 1, can be determined conventionally using known computer programs such the Bestfit program (Wisconsin Sequence Analysis Package, Version 8 for Unix, Genetics Computer Group, University Research Park, 575 Science Drive, Madison, WI 53711). When using Bestfit or any other sequence alignment program to determine whether a particular sequence is, for instance, 95% identical to a reference sequence according to the present invention, the parameters are set, of course, such that the percentage of identity is calculated over the full length of the reference amino acid sequence and that gaps in homology of up to 5% of the total number of amino acid residues in the reference sequence are allowed.

As described below, the polypeptides of the present invention can also be used to raise polyclonal and monoclonal antibodies, which are useful in assays for detecting *Streptococcal* protein expression.

In another aspect, the invention provides peptides and polypeptides comprising epitope-bearing portions of the *S. pneumoniae* polypeptides of the invention. These epitopes are immunogenic or antigenic epitopes of the polypeptides of the invention. An "immunogenic epitope" is defined as a part of a protein that elicits an antibody response when the whole protein or polypeptide is the immunogen. These immunogenic epitopes are believed to be confined to a few loci on the molecule. On the other hand, a region of a protein molecule to which an antibody can bind is defined as an "antigenic determinant" or "antigenic epitope." The number of immunogenic epitopes of a protein generally is less than the number of antigenic epitopes (Geysen, *et al.*, *Proc. Natl. Acad. Sci. USA* 81:3998- 4002 (1983)). Predicted antigenic epitopes are shown in Table 2, below.

As to the selection of peptides or polypeptides bearing an antigenic epitope (*i.e.*, that contain a region of a protein molecule to which an antibody can bind), it is well known in that art that relatively short synthetic peptides that mimic part of a protein sequence are routinely capable of eliciting an antiserum that reacts with the partially mimicked protein (for instance, Sutcliffe, J., *et al.*, *Science* 219:660-666 (1983)). Peptides capable of eliciting protein-reactive sera are frequently represented in the primary sequence of a protein, can be characterized by a set of simple chemical rules, and are confined neither to immunodominant regions of intact proteins (*i.e.*, immunogenic epitopes) nor to the amino or carboxyl terminals. Peptides that are extremely hydrophobic and those of six or fewer residues generally are ineffective at inducing antibodies that bind to the mimicked protein; longer, peptides, especially those containing proline residues, usually are effective (Sutcliffe, *et al.*, *supra*, p. 661). For instance, 18 of 20 peptides designed according to these guidelines, containing 8-39 residues covering 75% of the sequence of the influenza virus hemagglutinin HA1 polypeptide chain, induced antibodies that reacted with the HA1 protein or intact virus; and 12/12 peptides from the MuLV polymerase and 18/18 from the rabies glycoprotein induced antibodies that precipitated the respective proteins.

Antigenic epitope-bearing peptides and polypeptides of the invention are therefore useful to raise antibodies, including monoclonal antibodies, that bind specifically to a polypeptide of the invention. Thus, a high proportion of hybridomas obtained by fusion of spleen cells from donors immunized with an antigen epitope-bearing peptide generally secrete antibody reactive with the native protein (Sutcliffe, *et al.*, *supra*, p. 663). The antibodies raised by antigenic epitope-bearing peptides or polypeptides are useful to detect the mimicked protein, and antibodies to different peptides may be used for tracking the fate of various regions of a protein precursor which undergoes post-translational processing. The peptides and anti-peptide antibodies may be used in a variety of qualitative or quantitative assays for the mimicked protein, for instance in competition assays since it has been shown that even short peptides (*e.g.*, about 9 amino acids) can bind and displace the larger peptides in immunoprecipitation assays (for instance, Wilson, *et al.*, *Cell* 37:767-778 (1984) p. 777). The anti-peptide antibodies of the invention also are useful for purification of the mimicked protein, for instance, by adsorption chromatography using methods well known in the art.

Antigenic epitope-bearing peptides and polypeptides of the invention designed according to the above guidelines preferably contain a sequence of at

least seven, more preferably at least nine and most preferably between about 15 to about 30 amino acids contained within the amino acid sequence of a polypeptide of the invention. However, peptides or polypeptides comprising a larger portion of an amino acid sequence of a polypeptide of the invention, containing about 30 to about 50 amino acids, or any length up to and including the entire amino acid sequence of a polypeptide of the invention, also are considered epitope-bearing peptides or polypeptides of the invention and also are useful for inducing antibodies that react with the mimicked protein. Preferably, the amino acid sequence of the epitope-bearing peptide is selected to provide substantial solubility in aqueous solvents (*i.e.*, the sequence includes relatively hydrophilic residues and highly hydrophobic sequences are preferably avoided); and sequences containing proline residues are particularly preferred.

Non-limiting examples of antigenic polypeptides or peptides that can be used to generate *Streptococcal*-specific antibodies include portions of the amino acid sequences identified in Table 1. More specifically, Table 2 discloses antigenic fragments of polypeptides of the present invention, which antigenic fragments comprise amino acid sequences from about the first amino acid residues indicated to about the last amino acid residue indicated for each fragment. The polypeptide fragments disclosed in Table 2 are believed to be antigenic regions of the *S. pneumoniae* polypeptides described in Table 1. Thus the invention further includes isolated peptides and polypeptides comprising an amino acid sequence of an epitope shown in Table 2 and polynucleotides encoding said polypeptides.

The epitope-bearing peptides and polypeptides of the invention may be produced by any conventional means for making peptides or polypeptides including recombinant means using nucleic acid molecules of the invention. For instance, an epitope-bearing amino acid sequence of the present invention may be fused to a larger polypeptide which acts as a carrier during recombinant production and purification, as well as during immunization to produce anti-peptide antibodies. Epitope-bearing peptides also may be synthesized using known methods of chemical synthesis. For instance, Houghten has described a simple method for synthesis of large numbers of peptides, such as 10-20 mg of 248 different 13 residue peptides representing single amino acid variants of a segment of the HA1 polypeptide which were prepared and characterized (by ELISA-type binding studies) in less than four weeks (Houghten, R. A. Proc. Natl. Acad. Sci. USA 82:5131-5135 (1985)). This "Simultaneous Multiple Peptide Synthesis (SMPS)" process is further described in U.S. Patent No. 4,631,211 to Houghten and coworkers (1986). In this procedure the individual

resins for the solid-phase synthesis of various peptides are contained in separate solvent-permeable packets, enabling the optimal use of the many identical repetitive steps involved in solid-phase methods. A completely manual procedure allows 500-1000 or more syntheses to be conducted simultaneously (Houghten, *et al.*, *supra*, p. 5134).

Epitope-bearing peptides and polypeptides of the invention are used to induce antibodies according to methods well known in the art (for instance, Sutcliffe, *et al.*, *supra*; Wilson, *et al.*, *supra*; Chow, M., *et al.*, *Proc. Natl. Acad. Sci. USA* 82:910-914; and Bittle, F. J., *et al.*, *J. Gen. Virol.* 66:2347-2354 (1985)). Generally, animals may be immunized with free peptide; however, anti-peptide antibody titer may be boosted by coupling of the peptide to a macromolecular carrier, such as keyhole limpet hemacyanin (KLH) or tetanus toxoid. For instance, peptides containing cysteine may be coupled to carrier using a linker such as m-maleimidobenzoyl-N-hydroxysuccinimide ester (MBS), while other peptides may be coupled to carrier using a more general linking agent such as glutaraldehyde. Animals such as rabbits, rats and mice are immunized with either free or carrier-coupled peptides, for instance, by intraperitoneal and/or intradermal injection of emulsions containing about 100 µg peptide or carrier protein and Freund's adjuvant. Several booster injections may be needed, for instance, at intervals of about two weeks, to provide a useful titer of anti-peptide antibody which can be detected, for example, by ELISA assay using free peptide adsorbed to a solid surface. The titer of anti-peptide antibodies in serum from an immunized animal may be increased by selection of anti-peptide antibodies, for instance, by adsorption to the peptide on a solid support and elution of the selected antibodies according to methods well known in the art.

Immunogenic epitope-bearing peptides of the invention, *i.e.*, those parts of a protein that elicit an antibody response when the whole protein is the immunogen, are identified according to methods known in the art. For instance, Geysen, *et al.*, *supra*, discloses a procedure for rapid concurrent synthesis on solid supports of hundreds of peptides of sufficient purity to react in an enzyme-linked immunosorbent assay. Interaction of synthesized peptides with antibodies is then easily detected without removing them from the support. In this manner a peptide bearing an immunogenic epitope of a desired protein may be identified routinely by one of ordinary skill in the art. For instance, the immunologically important epitope in the coat protein of foot-and-mouth disease virus was located by Geysen *et al. supra* with a resolution of seven amino acids by synthesis of an overlapping set of all 208 possible hexapeptides covering the

entire 213 amino acid sequence of the protein. Then, a complete replacement set of peptides in which all 20 amino acids were substituted in turn at every position within the epitope were synthesized, and the particular amino acids conferring specificity for the reaction with antibody were determined. Thus, peptide  
5 analogs of the epitope-bearing peptides of the invention can be made routinely by this method. U.S. Patent No. 4,708,781 to Geysen (1987) further describes this method of identifying a peptide bearing an immunogenic epitope of a desired protein.

Further still, U.S. Patent No. 5,194,392, to Geysen (1990), describes a  
10 general method of detecting or determining the sequence of monomers (amino acids or other compounds) which is a topological equivalent of the epitope (*i.e.*, a "mimotope") which is complementary to a particular paratope (antigen binding site) of an antibody of interest. More generally, U.S. Patent No. 4,433,092, also to Geysen (1989), describes a method of detecting or determining a  
15 sequence of monomers which is a topographical equivalent of a ligand which is complementary to the ligand binding site of a particular receptor of interest. Similarly, U.S. Patent No. 5,480,971 to Houghten, R. A. *et al.* (1996) discloses linear C<sub>1</sub>-C<sub>7</sub>-alkyl peralkylated oligopeptides and sets and libraries of  
20 such peptides, as well as methods for using such oligopeptide sets and libraries for determining the sequence of a peralkylated oligopeptide that preferentially binds to an acceptor molecule of interest. Thus, non-peptide analogs of the epitope-bearing peptides of the invention also can be made routinely by these methods.

The entire disclosure of each document cited in this section on  
25 "Polypeptides and Fragments" is hereby incorporated herein by reference.

As one of skill in the art will appreciate, the polypeptides of the present invention and the epitope-bearing fragments thereof described above can be combined with parts of the constant domain of immunoglobulins (IgG), resulting in chimeric polypeptides. These fusion proteins facilitate purification  
30 and show an increased half-life *in vivo*. This has been shown, *e.g.*, for chimeric proteins consisting of the first two domains of the human CD4-polypeptide and various domains of the constant regions of the heavy or light chains of mammalian immunoglobulins (EPA 0,394,827; Traunecker *et al.*, *Nature* 331:84-86 (1988)). Fusion proteins that have a disulfide-linked  
35 dimeric structure due to the IgG part can also be more efficient in binding and neutralizing other molecules than a monomeric *S. pneumoniae* polypeptide or

fragment thereof alone (Fountoulakis *et al.*, *J. Biochem.* 270:3958-3964 (1995)).

### *Diagnostic Assays*

5           The present invention further relates to a method for assaying for *Streptococcal* infection in an animal *via* detecting the expression of genes encoding *Streptococcal* polypeptides (*e.g.*, the polypeptides described Table 1). This method comprises analyzing tissue or body fluid from the animal for *Streptococcus*-specific antibodies or *Streptococcal* nucleic acids or proteins.  
10       Analysis of nucleic acid specific to *Streptococcus* can be done by PCR or hybridization techniques using nucleic acid sequences of the present invention as either hybridization probes or primers (*cf. Molecular Cloning: A Laboratory Manual, second edition*, edited by Sambrook, Fritsch, & Maniatis, Cold Spring Harbor Laboratory, 1989; Ereemeeva *et al.*, *J. Clin. Microbiol.* 32:803-810  
15       (1994) which describes differentiation among spotted fever group *Rickettsiae* species by analysis of restriction fragment length polymorphism of PCR-amplified DNA). Methods for detecting *B. burgdorferi* nucleic acids *via* PCR are described, for example, in Chen *et al.*, *J. Clin. Microbiol.* 32:589-595 (1994).

20           Where diagnosis of a disease state related to infection with *Streptococcus* has already been made, the present invention is useful for monitoring progression or regression of the disease state whereby patients exhibiting enhanced *Streptococcus* gene expression will experience a worse clinical outcome relative to patients expressing these gene(s) at a lower level.

25           By "assaying for *Streptococcal* infection in an animal *via* detection of genes encoding *Streptococcal* polypeptides" is intended qualitatively or quantitatively measuring or estimating the level of one or more *Streptococcus* polypeptides or the level of nucleic acid encoding *Streptococcus* polypeptides in a first biological sample either directly (*e.g.*, by determining or estimating  
30       absolute protein level or nucleic level) or relatively (*e.g.*, by comparing to the *Streptococcus* polypeptide level or mRNA level in a second biological sample). The *Streptococcus* polypeptide level or nucleic acid level in the second sample used for a relative comparison may be undetectable if obtained from an animal which is not infected with *Streptococcus*. When monitoring the progression or  
35       regression of a disease state, the *Streptococcus* polypeptide level or nucleic acid level may be compared to a second sample obtained from either an animal infected with *Streptococcus* or the same animal from which the first sample was obtained but taken from that animal at a different time than the first. As will be

appreciated in the art, once a standard *Streptococcus* polypeptide level or nucleic acid level which corresponds to a particular stage of a *Streptococcus* infection is known, it can be used repeatedly as a standard for comparison.

5 By "biological sample" is intended any biological sample obtained from an animal, cell line, tissue culture, or other source which contains *Streptococcus* polypeptide, mRNA, or DNA. Biological samples include body fluids (such as plasma and synovial fluid) which contain *Streptococcus* polypeptides, and muscle, skin, and cartilage tissues. Methods for obtaining tissue biopsies and body fluids are well known in the art.

10 The present invention is useful for detecting diseases related to *Streptococcus* infections in animals. Preferred animals include monkeys, apes, cats, dogs, cows, pigs, mice, horses, rabbits and humans. Particularly preferred are humans.

15 Total RNA can be isolated from a biological sample using any suitable technique such as the single-step guanidinium-thiocyanate-phenol-chloroform method described in Chomczynski and Sacchi, *Anal. Biochem.* 162:156-159 (1987). mRNA encoding *Streptococcus* polypeptides having sufficient homology to the nucleic acid sequences identified in Table 1 to allow for hybridization between complementary sequences are then assayed using any  
20 appropriate method. These include Northern blot analysis, S1 nuclease mapping, the polymerase chain reaction (PCR), reverse transcription in combination with the polymerase chain reaction (RT-PCR), and reverse transcription in combination with the ligase chain reaction (RT-LCR).

25 Northern blot analysis can be performed as described in Harada *et al.*, *Cell* 63:303-312 (1990). Briefly, total RNA is prepared from a biological sample as described above. For the Northern blot, the RNA is denatured in an appropriate buffer (such as glyoxal/dimethyl sulfoxide/sodium phosphate buffer), subjected to agarose gel electrophoresis, and transferred onto a nitrocellulose filter. After the RNAs have been linked to the filter by a UV  
30 linker, the filter is prehybridized in a solution containing formamide, SSC, Denhardt's solution, denatured salmon sperm, SDS, and sodium phosphate buffer. A *S. pneumoniae* polypeptide DNA sequence shown in Table 1 labeled according to any appropriate method (such as the <sup>32</sup>P-multiprimed DNA labeling system (Amersham)) is used as probe. After hybridization overnight, the filter  
35 is washed and exposed to x-ray film. DNA for use as probe according to the present invention is described in the sections above and will preferably at least 15 bp in length.

S1 mapping can be performed as described in Fujita *et al.*, *Cell* 49:357-367 (1987). To prepare probe DNA for use in S1 mapping, the sense strand of an above-described *S. pneumoniae* DNA sequence of the present invention is used as a template to synthesize labeled antisense DNA. The antisense DNA can then be digested using an appropriate restriction endonuclease to generate further DNA probes of a desired length. Such antisense probes are useful for visualizing protected bands corresponding to the target mRNA (*i.e.*, mRNA encoding *Streptococcus* polypeptides).

Preferably, levels of mRNA encoding *Streptococcus* polypeptides are assayed using the RT-PCR method described in Makino *et al.*, *Technique* 2:295-301 (1990). By this method, the radioactivities of the "amplicons" in the polyacrylamide gel bands are linearly related to the initial concentration of the target mRNA. Briefly, this method involves adding total RNA isolated from a biological sample in a reaction mixture containing a RT primer and appropriate buffer. After incubating for primer annealing, the mixture can be supplemented with a RT buffer, dNTPs, DTT, RNase inhibitor and reverse transcriptase. After incubation to achieve reverse transcription of the RNA, the RT products are then subject to PCR using labeled primers. Alternatively, rather than labeling the primers, a labeled dNTP can be included in the PCR reaction mixture. PCR amplification can be performed in a DNA thermal cycler according to conventional techniques. After a suitable number of rounds to achieve amplification, the PCR reaction mixture is electrophoresed on a polyacrylamide gel. After drying the gel, the radioactivity of the appropriate bands (corresponding to the mRNA encoding the *Streptococcus* polypeptides)) is quantified using an imaging analyzer. RT and PCR reaction ingredients and conditions, reagent and gel concentrations, and labeling methods are well known in the art. Variations on the RT-PCR method will be apparent to the skilled artisan.

Assaying *Streptococcus* polypeptide levels in a biological sample can occur using any art-known method. Preferred for assaying *Streptococcus* polypeptide levels in a biological sample are antibody-based techniques. For example, *Streptococcus* polypeptide expression in tissues can be studied with classical immunohistological methods. In these, the specific recognition is provided by the primary antibody (polyclonal or monoclonal) but the secondary detection system can utilize fluorescent, enzyme, or other conjugated secondary antibodies. As a result, an immunohistological staining of tissue section for pathological examination is obtained. Tissues can also be extracted, *e.g.*, with urea and neutral detergent, for the liberation of *Streptococcus* polypeptides for



Western-blot or dot/slot assay (Jalkanen, M., *et al.*, *J. Cell. Biol.* 101:976-985 (1985); Jalkanen, M., *et al.*, *J. Cell. Biol.* 105:3087-3096 (1987)). In this technique, which is based on the use of cationic solid phases, quantitation of a *Streptococcus* polypeptide can be accomplished using an isolated *Streptococcus* polypeptide as a standard. This technique can also be applied to body fluids.

Other antibody-based methods useful for detecting *Streptococcus* polypeptide gene expression include immunoassays, such as the enzyme linked immunosorbent assay (ELISA) and the radioimmunoassay (RIA). For example, a *Streptococcus* polypeptide-specific monoclonal antibodies can be used both as an immunoabsorbent and as an enzyme-labeled probe to detect and quantify a *Streptococcus* polypeptide. The amount of a *Streptococcus* polypeptide present in the sample can be calculated by reference to the amount present in a standard preparation using a linear regression computer algorithm. Such an ELISA for detecting a tumor antigen is described in Iacobelli *et al.*, *Breast Cancer Research and Treatment* 11:19-30 (1988). In another ELISA assay, two distinct specific monoclonal antibodies can be used to detect *Streptococcus* polypeptides in a body fluid. In this assay, one of the antibodies is used as the immunoabsorbent and the other as the enzyme-labeled probe.

The above techniques may be conducted essentially as a "one-step" or "two-step" assay. The "one-step" assay involves contacting the *Streptococcus* polypeptide with immobilized antibody and, without washing, contacting the mixture with the labeled antibody. The "two-step" assay involves washing before contacting the mixture with the labeled antibody. Other conventional methods may also be employed as suitable. It is usually desirable to immobilize one component of the assay system on a support, thereby allowing other components of the system to be brought into contact with the component and readily removed from the sample.

*Streptococcus* polypeptide-specific antibodies for use in the present invention can be raised against an intact *S. pneumoize* polypeptide of the present invention or fragment thereof. These polypeptides and fragments may be administered to an animal (*e.g.*, rabbit or mouse) either with a carrier protein (*e.g.*, albumin) or, if long enough (*e.g.*, at least about 25 amino acids), without a carrier.

As used herein, the term "antibody" (Ab) or "monoclonal antibody" (Mab) is meant to include intact molecules as well as antibody fragments (such as, for example, Fab and F(ab')<sub>2</sub> fragments) which are capable of specifically binding to a *Streptococcus* polypeptide. Fab and F(ab')<sub>2</sub> fragments lack the Fc fragment of intact antibody, clear more rapidly from the circulation, and may

have less non-specific tissue binding of an intact antibody (Wahl *et al.*, *J. Nucl. Med.* 24:316-325 (1983)). Thus, these fragments are preferred.

The antibodies of the present invention may be prepared by any of a variety of methods. For example, the *S. pneumoniae* polypeptides identified in Table 1, or fragments thereof, can be administered to an animal in order to induce the production of sera containing polyclonal antibodies. In a preferred method, a preparation of a *S. pneumoniae* polypeptide of the present invention is prepared and purified to render it substantially free of natural contaminants. Such a preparation is then introduced into an animal in order to produce polyclonal antisera of high specific activity.

In the most preferred method, the antibodies of the present invention are monoclonal antibodies. Such monoclonal antibodies can be prepared using hybridoma technology (Kohler *et al.*, *Nature* 256:495 (1975); Kohler *et al.*, *Eur. J. Immunol.* 6:511 (1976); Kohler *et al.*, *Eur. J. Immunol.* 6:292 (1976); Hammerling *et al.*, In: *Monoclonal Antibodies and T-Cell Hybridomas*; Elsevier, N.Y., (1981) pp. 563-681). In general, such procedures involve immunizing an animal (preferably a mouse) with a *S. pneumoniae* polypeptide antigen of the present invention. Suitable cells can be recognized by their capacity to bind anti-*Streptococcus* polypeptide antibody. Such cells may be cultured in any suitable tissue culture medium; however, it is preferable to culture cells in Earle's modified Eagle's medium supplemented with 10% fetal bovine serum (inactivated at about 56°C), and supplemented with about 10 g/l of nonessential amino acids, about 1,000 U/ml of penicillin, and about 100 µg/ml of streptomycin. The splenocytes of such mice are extracted and fused with a suitable myeloma cell line. Any suitable myeloma cell line may be employed in accordance with the present invention; however, it is preferable to employ the parent myeloma cell line (SP<sub>2</sub>O), available from the American Type Culture Collection, Rockville, Maryland. After fusion, the resulting hybridoma cells are selectively maintained in HAT medium, and then cloned by limiting dilution as described by Wands *et al.* (*Gastroenterology* 80:225-232 (1981)). The hybridoma cells obtained through such a selection are then assayed to identify clones which secrete antibodies capable of binding the *Streptococcus* polypeptide antigen administered to immunized animal.

Alternatively, additional antibodies capable of binding to *Streptococcus* polypeptide antigens may be produced in a two-step procedure through the use of anti-idiotypic antibodies. Such a method makes use of the fact that antibodies are themselves antigens, and that, therefore, it is possible to obtain an antibody

which binds to a second antibody. In accordance with this method, *Streptococcus* polypeptide-specific antibodies are used to immunize an animal, preferably a mouse. The splenocytes of such an animal are then used to produce hybridoma cells, and the hybridoma cells are screened to identify clones which produce an antibody whose ability to bind to the *Streptococcus* polypeptide-specific antibody can be blocked by a *Streptococcus* polypeptide antigen. Such antibodies comprise anti-idiotypic antibodies to the *Streptococcus* polypeptide-specific antibody and can be used to immunize an animal to induce formation of further *Streptococcus* polypeptide-specific antibodies.

It will be appreciated that Fab and F(ab')<sub>2</sub> and other fragments of the antibodies of the present invention may be used according to the methods disclosed herein. Such fragments are typically produced by proteolytic cleavage, using enzymes such as papain (to produce Fab fragments) or pepsin (to produce F(ab')<sub>2</sub> fragments). Alternatively, *Streptococcus* polypeptide-binding fragments can be produced through the application of recombinant DNA technology or through synthetic chemistry.

Of special interest to the present invention are antibodies to *Streptococcus* polypeptide antigens which are produced in humans, or are "humanized" (i.e., non-immunogenic in a human) by recombinant or other technology. Humanized antibodies may be produced, for example by replacing an immunogenic portion of an antibody with a corresponding, but non-immunogenic portion (i.e., chimeric antibodies) (Robinson, R.R. *et al.*, International Patent Publication PCT/US86/02269; Akira, K. *et al.*, European Patent Application 184,187; Taniguchi, M., European Patent Application 171,496; Morrison, S.L. *et al.*, European Patent Application 173,494; Neuberger, M.S. *et al.*, PCT Application WO 86/01533; Cabilly, S. *et al.*, European Patent Application 125,023; Better, M. *et al.*, *Science* 240:1041-1043 (1988); Liu, A.Y. *et al.*, *Proc. Natl. Acad. Sci. USA* 84:3439-3443 (1987); Liu, A.Y. *et al.*, *J. Immunol.* 139:3521-3526 (1987); Sun, L.K. *et al.*, *Proc. Natl. Acad. Sci. USA* 84:214-218 (1987); Nishimura, Y. *et al.*, *Canc. Res.* 47:999-1005 (1987); Wood, C.R. *et al.*, *Nature* 314:446-449 (1985); Shaw *et al.*, *J. Natl. Cancer Inst.* 80:1553-1559 (1988). General reviews of "humanized" chimeric antibodies are provided by Morrison, S.L. (*Science*, 229:1202-1207 (1985)) and by Oi, V.T. *et al.*, *BioTechniques* 4:214 (1986). Suitable "humanized" antibodies can be alternatively produced by CDR or CEA substitution (Jones, P.T. *et al.*, *Nature* 321:552-525 (1986);

Verhoeven *et al.*, *Science* 239:1534 (1988); Beidler, C.B. *et al.*, *J. Immunol.* 141:4053-4060 (1988)).

Suitable enzyme labels include, for example, those from the oxidase group, which catalyze the production of hydrogen peroxide by reacting with substrate. Glucose oxidase is particularly preferred as it has good stability and its substrate (glucose) is readily available. Activity of an oxidase label may be assayed by measuring the concentration of hydrogen peroxide formed by the enzyme-labeled antibody/substrate reaction. Besides enzymes, other suitable labels include radioisotopes, such as iodine ( $^{125}\text{I}$ ,  $^{121}\text{I}$ ), carbon ( $^{14}\text{C}$ ), sulphur ( $^{35}\text{S}$ ), tritium ( $^3\text{H}$ ), indium ( $^{112}\text{In}$ ), and technetium ( $^{99\text{m}}\text{Tc}$ ), and fluorescent labels, such as fluorescein and rhodamine, and biotin.

Further suitable labels for the *Streptococcus* polypeptide-specific antibodies of the present invention are provided below. Examples of suitable enzyme labels include malate dehydrogenase, staphylococcal nuclease, delta-5-steroid isomerase, yeast-alcohol dehydrogenase, alpha-glycerol phosphate dehydrogenase, triose phosphate isomerase, peroxidase, alkaline phosphatase, asparaginase, glucose oxidase, beta-galactosidase, ribonuclease, urease, catalase, glucose-6-phosphate dehydrogenase, glucoamylase, and acetylcholine esterase.

Examples of suitable radioisotopic labels include  $^3\text{H}$ ,  $^{111}\text{In}$ ,  $^{125}\text{I}$ ,  $^{131}\text{I}$ ,  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$ ,  $^{51}\text{Cr}$ ,  $^{57}\text{Co}$ ,  $^{58}\text{Co}$ ,  $^{59}\text{Fe}$ ,  $^{75}\text{Se}$ ,  $^{152}\text{Eu}$ ,  $^{90}\text{Y}$ ,  $^{67}\text{Cu}$ ,  $^{217}\text{Bi}$ ,  $^{211}\text{At}$ ,  $^{212}\text{Pb}$ ,  $^{47}\text{Sc}$ ,  $^{109}\text{Pd}$ , etc.  $^{111}\text{In}$  is a preferred isotope where *in vivo* imaging is used since it avoids the problem of dehalogenation of the  $^{125}\text{I}$  or  $^{131}\text{I}$ -labeled monoclonal antibody by the liver. In addition, this radionuclide has a more favorable gamma emission energy for imaging (Perkins *et al.*, *Eur. J. Nucl. Med.* 10:296-301 (1985); Carasquillo *et al.*, *J. Nucl. Med.* 28:281-287 (1987)). For example,  $^{111}\text{In}$  coupled to monoclonal antibodies with 1-(P-isothiocyanatobenzyl)-DPTA has shown little uptake in non-tumorous tissues, particularly the liver, and therefore enhances specificity of tumor localization (Esteban *et al.*, *J. Nucl. Med.* 28:861-870 (1987)).

Examples of suitable non-radioactive isotopic labels include  $^{157}\text{Gd}$ ,  $^{55}\text{Mn}$ ,  $^{162}\text{Dy}$ ,  $^{52}\text{Tr}$ , and  $^{56}\text{Fe}$ .

Examples of suitable fluorescent labels include an  $^{152}\text{Eu}$  label, a fluorescein label, an isothiocyanate label, a rhodamine label, a phycoerythrin label, a phycocyanin label, an allophycocyanin label, an o-phthalaldehyde label, and a fluorescamine label.

Examples of suitable toxin labels include diphtheria toxin, ricin, and cholera toxin.

Examples of chemiluminescent labels include a luminal label, an isoluminal label, an aromatic acridinium ester label, an imidazole label, an acridinium salt label, an oxalate ester label, a luciferin label, a luciferase label, and an aequorin label.

5        Examples of nuclear magnetic resonance contrasting agents include heavy metal nuclei such as Gd, Mn, and iron.

Typical techniques for binding the above-described labels to antibodies are provided by Kennedy *et al.*, *Clin. Chim. Acta* 70:1-31 (1976), and Schurs *et al.*, *Clin. Chim. Acta* 81:1-40 (1977). Coupling techniques mentioned in the  
10        latter are the glutaraldehyde method, the periodate method, the dimaleimide method, the m-maleimidobenzyl-N-hydroxy-succinimide ester method, all of which methods are incorporated by reference herein.

In a related aspect, the invention includes a diagnostic kit for use in screening serum containing antibodies specific against *S. pneumoniae*  
15        infection. Such a kit may include an isolated *S. pneumoniae* antigen comprising an epitope which is specifically immunoreactive with at least one anti-*S. pneumoniae* antibody. Such a kit also includes means for detecting the binding of said antibody to the antigen. In specific embodiments, the kit may include a recombinantly produced or chemically synthesized peptide or polypeptide  
20        antigen. The peptide or polypeptide antigen may be attached to a solid support.

In a more specific embodiment, the detecting means of the above-described kit includes a solid support to which said peptide or polypeptide antigen is attached. Such a kit may also include a non-attached reporter-labelled anti-human antibody. In this embodiment, binding of the antibody to the *S.*  
25        *pneumoniae* antigen can be detected by binding of the reporter labelled antibody to the anti-*S. pneumoniae* antibody.

In a related aspect, the invention includes a method of detecting *S. pneumoniae* infection in a subject. This detection method includes reacting a body fluid, preferably serum, from the subject with an isolated *S. pneumoniae*  
30        antigen, and examining the antigen for the presence of bound antibody. In a specific embodiment, the method includes a polypeptide antigen attached to a solid support, and serum is reacted with the support. Subsequently, the support is reacted with a reporter-labelled anti-human antibody. The support is then examined for the presence of reporter-labelled antibody.

35        The solid surface reagent employed in the above assays and kits is prepared by known techniques for attaching protein material to solid support material, such as polymeric beads, dip sticks, 96-well plates or filter material. These attachment methods generally include non-specific adsorption of the

protein to the support or covalent attachment of the protein, typically through a free amine group, to a chemically reactive group on the solid support, such as an activated carboxyl, hydroxyl, or aldehyde group. Alternatively, streptavidin coated plates can be used in conjunction with biotinylated antigen(s).

5

### *Therapeutics and Modes of Administration*

The present invention also provides vaccines comprising one or more polypeptides of the present invention. Heterogeneity in the composition of a vaccine may be provided by combining *S. pneumoniae* polypeptides of the present invention. Multi-component vaccines of this type are desirable because they are likely to be more effective in eliciting protective immune responses against multiple species and strains of the *Streptococcus* genus than single polypeptide vaccines. Thus, as discussed in detail below, a multi-component vaccine of the present invention may contain one or more, preferably 2 to about 20, more preferably 2 to about 15, and most preferably 3 to about 8, of the *S. pneumoniae* polypeptides identified in Table 1, or fragments thereof.

Multi-component vaccines are known in the art to elicit antibody production to numerous immunogenic components. Decker, M. and Edwards, K., *J. Infect. Dis.* 174:S270-275 (1996). In addition, a hepatitis B, diphtheria, tetanus, pertussis tetravalent vaccine has recently been demonstrated to elicit protective levels of antibodies in human infants against all four pathogenic agents. Aristegui, J. *et al.*, *Vaccine* 15:7-9 (1997).

The present invention thus also includes multi-component vaccines. These vaccines comprise more than one polypeptide, immunogen or antigen. An example of such a multi-component vaccine would be a vaccine comprising more than one of the *S. pneumoniae* polypeptides described in Table 1. A second example is a vaccine comprising one or more, for example 2 to 10, of the *S. pneumoniae* polypeptides identified in Table 1 and one or more, for example 2 to 10, additional polypeptides of either streptococcal or non-streptococcal origin. Thus, a multi-component vaccine which confers protective immunity to both a Streptococcal infection and infection by another pathogenic agent is also within the scope of the invention.

As indicated above, the vaccines of the present invention are expected to elicit a protective immune response against infections caused by species and strains of *Streptococcus* other than strain of *S. pneumoniae* deposited with that ATCC.

Further within the scope of the invention are whole cell and whole viral vaccines. Such vaccines may be produced recombinantly and involve the

expression of one or more of the *S. pneumoniae* polypeptides described in Table 1. For example, the *S. pneumoniae* polypeptides of the present invention may be either secreted or localized intracellular, on the cell surface, or in the periplasmic space. Further, when a recombinant virus is used, the *S. pneumoniae* polypeptides of the present invention may, for example, be localized in the viral envelope, on the surface of the capsid, or internally within the capsid. Whole cells vaccines which employ cells expressing heterologous proteins are known in the art. See, e.g., Robinson, K. *et al.*, *Nature Biotech.* 15:653-657 (1997); Sirard, J. *et al.*, *Infect. Immun.* 65:2029-2033 (1997); Chabalgoity, J. *et al.*, *Infect. Immun.* 65:2402-2412 (1997). These cells may be administered live or may be killed prior to administration. Chabalgoity, J. *et al.*, *supra*, for example, report the successful use in mice of a live attenuated *Salmonella* vaccine strain which expresses a portion of a platyhelminth fatty acid-binding protein as a fusion protein on its cells surface.

A multi-component vaccine can also be prepared using techniques known in the art by combining one or more *S. pneumoniae* polypeptides of the present invention, or fragments thereof, with additional non-streptococcal components (e.g., diphtheria toxin or tetanus toxin, and/or other compounds known to elicit an immune response). Such vaccines are useful for eliciting protective immune responses to both members of the *Streptococcus* genus and non-streptococcal pathogenic agents.

The vaccines of the present invention also include DNA vaccines. DNA vaccines are currently being developed for a number of infectious diseases. Boyer, J *et al.*, *Nat. Med.* 3:526-532 (1997); reviewed in Spier, R., *Vaccine* 14:1285-1288 (1996). Such DNA vaccines contain a nucleotide sequence encoding one or more *S. pneumoniae* polypeptides of the present invention oriented in a manner that allows for expression of the subject polypeptide. The direct administration of plasmid DNA encoding *B. burgdorgeri* OspA has been shown to elicit protective immunity in mice against borrelial challenge. Luke, C. *et al.*, *J. Infect. Dis.* 175:91-97 (1997).

The present invention also relates to the administration of a vaccine which is co-administered with a molecule capable of modulating immune responses. Kim, J. *et al.*, *Nature Biotech.* 15:641-646 (1997), for example, report the enhancement of immune responses produced by DNA immunizations when DNA sequences encoding molecules which stimulate the immune response are co-administered. In a similar fashion, the vaccines of the present invention may be co-administered with either nucleic acids encoding immune modulators or the immune modulators themselves. These immune modulators

include granulocyte macrophage colony stimulating factor (GM-CSF) and CD86.

The vaccines of the present invention may be used to confer resistance to streptococcal infection by either passive or active immunization. When the vaccines of the present invention are used to confer resistance to streptococcal infection through active immunization, a vaccine of the present invention is administered to an animal to elicit a protective immune response which either prevents or attenuates a streptococcal infection. When the vaccines of the present invention are used to confer resistance to streptococcal infection through passive immunization, the vaccine is provided to a host animal (*e.g.*, human, dog, or mouse), and the antisera elicited by this antisera is recovered and directly provided to a recipient suspected of having an infection caused by a member of the *Streptococcus* genus.

The ability to label antibodies, or fragments of antibodies, with toxin molecules provides an additional method for treating streptococcal infections when passive immunization is conducted. In this embodiment, antibodies, or fragments of antibodies, capable of recognizing the *S. pneumoniae* polypeptides disclosed herein, or fragments thereof, as well as other *Streptococcus* proteins, are labeled with toxin molecules prior to their administration to the patient. When such toxin derivatized antibodies bind to *Streptococcus* cells, toxin moieties will be localized to these cells and will cause their death.

The present invention thus concerns and provides a means for preventing or attenuating a streptococcal infection resulting from organisms which have antigens that are recognized and bound by antisera produced in response to the polypeptides of the present invention. As used herein, a vaccine is said to prevent or attenuate a disease if its administration to an animal results either in the total or partial attenuation (*i.e.*, suppression) of a symptom or condition of the disease, or in the total or partial immunity of the animal to the disease.

The administration of the vaccine (or the antisera which it elicits) may be for either a "prophylactic" or "therapeutic" purpose. When provided prophylactically, the compound(s) are provided in advance of any symptoms of streptococcal infection. The prophylactic administration of the compound(s) serves to prevent or attenuate any subsequent infection. When provided therapeutically, the compound(s) is provided upon or after the detection of symptoms which indicate that an animal may be infected with a member of the *Streptococcus* genus. The therapeutic administration of the compound(s) serves to attenuate any actual infection. Thus, the *S. pneumoniae* polypeptides, and



fragments thereof, of the present invention may be provided either prior to the onset of infection (so as to prevent or attenuate an anticipated infection) or after the initiation of an actual infection.

5 The polypeptides of the invention, whether encoding a portion of a native protein or a functional derivative thereof, may be administered in pure form or may be coupled to a macromolecular carrier. Example of such carriers are proteins and carbohydrates. Suitable proteins which may act as macromolecular carrier for enhancing the immunogenicity of the polypeptides of the present invention include keyhole limpet hemacyanin (KLH) tetanus toxoid, 10 pertussis toxin, bovine serum albumin, and ovalbumin. Methods for coupling the polypeptides of the present invention to such macromolecular carriers are disclosed in Harlow *et al.*, *Antibodies: A Laboratory Manual*, 2nd Ed.; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York (1988), the entire disclosure of which is incorporated by reference herein.

15 A composition is said to be "pharmacologically acceptable" if its administration can be tolerated by a recipient animal and is otherwise suitable for administration to that animal. Such an agent is said to be administered in a "therapeutically effective amount" if the amount administered is physiologically significant. An agent is physiologically significant if its presence results in a 20 detectable change in the physiology of a recipient patient.

While in all instances the vaccine of the present invention is administered as a pharmacologically acceptable compound, one skilled in the art would recognize that the composition of a pharmacologically acceptable compound varies with the animal to which it is administered. For example, a vaccine 25 intended for human use will generally not be co-administered with Freund's adjuvant. Further, the level of purity of the *S. pneumoniae* polypeptides of the present invention will normally be higher when administered to a human than when administered to a non-human animal.

30 As would be understood by one of ordinary skill in the art, when the vaccine of the present invention is provided to an animal, it may be in a composition which may contain salts, buffers, adjuvants, or other substances which are desirable for improving the efficacy of the composition. Adjuvants are substances that can be used to specifically augment a specific immune response. These substances generally perform two functions: (1) they protect 35 the antigen(s) from being rapidly catabolized after administration and (2) they nonspecifically stimulate immune responses.

Normally, the adjuvant and the composition are mixed prior to presentation to the immune system, or presented separately, but into the same

site of the animal being immunized. Adjuvants can be loosely divided into several groups based upon their composition. These groups include oil adjuvants (for example, Freund's complete and incomplete), mineral salts (for example,  $\text{AlK}(\text{SO}_4)_2$ ,  $\text{AlNa}(\text{SO}_4)_2$ ,  $\text{AlNH}_4(\text{SO}_4)$ , silica, kaolin, and carbon),  
5 polynucleotides (for example, poly IC and poly AU acids), and certain natural substances (for example, wax D from *Mycobacterium tuberculosis*, as well as substances found in *Corynebacterium parvum*, or *Bordetella pertussis*, and members of the genus *Brucella*. Other substances useful as adjuvants are the saponins such as, for example, Quil A. (Superfos A/S, Denmark). Preferred  
10 adjuvants for use in the present invention include aluminum salts, such as  $\text{AlK}(\text{SO}_4)_2$ ,  $\text{AlNa}(\text{SO}_4)_2$ , and  $\text{AlNH}_4(\text{SO}_4)$ . Examples of materials suitable for use in vaccine compositions are provided in *Remington's Pharmaceutical Sciences* (Osol, A, Ed, Mack Publishing Co, Easton, PA, pp. 1324-1341 (1980), which reference is incorporated herein by reference).

15 The therapeutic compositions of the present invention can be administered parenterally by injection, rapid infusion, nasopharyngeal absorption (intranasopharangeally), dermoabsorption, or orally. The compositions may alternatively be administered intramuscularly, or intravenously. Compositions for parenteral administration include sterile  
20 aqueous or non-aqueous solutions, suspensions, and emulsions. Examples of non-aqueous solvents are propylene glycol, polyethylene glycol, vegetable oils such as olive oil, and injectable organic esters such as ethyl oleate. Carriers or occlusive dressings can be used to increase skin permeability and enhance antigen absorption. Liquid dosage forms for oral administration may generally  
25 comprise a liposome solution containing the liquid dosage form. Suitable forms for suspending liposomes include emulsions, suspensions, solutions, syrups, and elixirs containing inert diluents commonly used in the art, such as purified water. Besides the inert diluents, such compositions can also include adjuvants, wetting agents, emulsifying and suspending agents, or sweetening, flavoring,  
30 or perfuming agents.

Therapeutic compositions of the present invention can also be administered in encapsulated form. For example, intranasal immunization of mice against *Bordetella pertussis* infection using vaccines encapsulated in biodegradable microsphere composed of poly(DL-lactide-co-glycolide) has been  
35 shown to stimulate protective immune responses. Shahin, R. *et al.*, *Infect. Immun.* 63:1195-1200 (1995). Similarly, orally administered encapsulated *Salmonella typhimurium* antigens have also been shown to elicit protective

immunity in mice. Allaoui-Attarki, K. *et al.*, *Infect. Immun.* 65:853-857 (1997). Encapsulated vaccines of the present invention can be administered by a variety of routes including those involving contacting the vaccine with mucous membranes (*e.g.*, intranasally, intracolonicly, intraduodenally).

5 Many different techniques exist for the timing of the immunizations when a multiple administration regimen is utilized. It is possible to use the compositions of the invention more than once to increase the levels and diversities of expression of the immunoglobulin repertoire expressed by the immunized animal. Typically, if multiple immunizations are given, they will be  
10 given one to two months apart.

According to the present invention, an "effective amount" of a therapeutic composition is one which is sufficient to achieve a desired biological effect. Generally, the dosage needed to provide an effective amount of the composition will vary depending upon such factors as the animal's or human's  
15 age, condition, sex, and extent of disease, if any, and other variables which can be adjusted by one of ordinary skill in the art.

The antigenic preparations of the invention can be administered by either single or multiple dosages of an effective amount. Effective amounts of the compositions of the invention can vary from 0.01-1,000 µg/ml per dose, more  
20 preferably 0.1-500 µg/ml per dose, and most preferably 10-300 µg/ml per dose.

Having now generally described the invention, the same will be more readily understood through reference to the following example which is provided by way of illustration, and is not intended to be limiting of the present  
25 invention, unless specified.

### **Examples**

#### **Example 1: Expression and Purification of *S. pneumoniae* Polypeptides in *E. coli***

30 The bacterial expression vector pQE10 (QIAGEN, Inc., 9259 Eton Avenue, Chatsworth, CA, 91311) is used in this example for cloning of the nucleotide sequences shown in Table 1 and for expressing the polypeptides identified in Table 1. The components of the pQE10 plasmid are arranged such that the inserted DNA sequence encoding a polypeptide of the present invention  
35 expresses the polypeptide with the six His residues (*i.e.*, a "6 X His tag")) covalently linked to the amino terminus.

The DNA sequences encoding the desired portions of the polypeptides of Table 1 are amplified using PCR oligonucleotide primers from either a DNA

library constructed from *S. pneumoniae*, such as the one deposited by the inventors at the ATCC for convenience, ATCC Deposit No. 97755, or from DNA isolated from the same organism such as the *S. pneumoniae* strain deposited with the ATCC as Deposit No. 55840. A list of PCR primers which can be used for this purpose is provided in Table 3, below. The PCR primers anneal to the nucleotide sequences encoding both the amino terminal and carboxy terminal amino acid sequences of the desired portion of the polypeptides of Table 1. Additional nucleotides containing restriction sites to facilitate cloning in the pQE10 vector were added to the 5' and 3' primer sequences, respectively. Such restriction sites are listed in Table 3 for each primer. In each case, the primer comprises, from the 5' end, 4 random nucleotides to prevent "breathing" during the annealing process, a restriction site (shown in Table 3), and approximately 15 nucleotides of *S. pneumoniae* ORF sequence (the complete sequence of each cloning primer is shown as SEQ ID NO:227 through SEQ ID NO:452).

For cloning the polypeptides of Table 1, the 5' and 3' primers were selected to amplify their respective nucleotide coding sequences. One of ordinary skill in the art would appreciate that the point in the protein coding sequence where the 5' primer begins may be varied to amplify a DNA segment encoding any desired portion of the complete amino acid sequences described in Table 1. Similarly, one of ordinary skill in the art would further appreciate that the point in the protein coding sequence where the 3' primer begins may also be varied to amplify a DNA segment encoding any desired portion of the complete amino acid sequences described in Table 1.

The amplified DNA fragment and the pQE10 vector are digested with the appropriate restriction enzyme(s) and the digested DNAs are then ligated together. The ligation mixture is transformed into competent *E. coli* cells using standard procedures such as those described in Sambrook *et al.*, *Molecular Cloning: a Laboratory Manual*, 2nd Ed.; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989). Transformants are identified by their ability to grow under selective pressure on LB plates. Plasmid DNA is isolated from resistant colonies and the identity of the cloned DNA confirmed by restriction analysis, PCR and DNA sequencing.

Clones containing the desired constructs are grown overnight ("O/N") in liquid culture under selection. The O/N culture is used to inoculate a large culture, at a dilution of approximately 1:25 to 1:250. The cells are grown to an optical density at 600 nm ("OD600") of between 0.4 and 0.6. Isopropyl-b-D-thiogalactopyranoside ("IPTG") is then added to a final concentration of 1 mM

to induce transcription from the *lac* repressor sensitive promoter, by inactivating the *lacI* repressor. Cells subsequently are incubated further for 3 to 4 hours. Cells are then harvested by centrifugation.

5 The cells are stirred for 3-4 hours at 4 C in 6M guanidine-HCl, pH 8. The cell debris is removed by centrifugation, and the supernatant containing the protein of interest is loaded onto a nickel-nitrilo-tri-acetic acid ("NiNTA") affinity resin column (available from QIAGEN, Inc., *supra*). Proteins with a 6x His tag bind to the NI-NTA resin with high affinity and can be purified in a simple one-step procedure (for details see: The QIAexpressionist, 1995, QIAGEN, Inc., *supra*).  
10 Briefly, the supernatant is loaded onto the column in 6 M guanidine-HCl, pH8, the column is first washed with 10 volumes of 6 M guanidine-HCl, pH8, then washed with 10 volumes of 6 M guanidine-HCl pH6, and finally the polypeptide is eluted with 6 M guanidine-HCl, pH 5.0.

15 The purified protein is then renatured by dialyzing it against phosphate-buffered saline (PBS) or 50 mM Na-acetate, pH 6 buffer plus 200 mM NaCl. Alternatively, the protein can be successfully refolded while immobilized on the Ni-NTA column. The recommended conditions are as follows: renature using a linear 6M-1M urea gradient in 500 mM NaCl, 20% glycerol, 20 mM Tris/HCl pH7.4, containing protease inhibitors. The renaturation should be performed  
20 over a period of 1.5 hours or more. After renaturation the proteins can be eluted by the addition of 250 mM imidazole. Imidazole is removed by a final dialyzing step against PBS or 50 mM sodium acetate pH6 buffer plus 200 mM NaCl. The purified protein is stored at 4°C or frozen at -80°C.

25 The DNA sequences encoding the amino acid sequences of Table 1 may also be cloned and expressed as fusion proteins by a protocol similar to that described directly above, wherein the pET-32b(+) vector (Novagen, 601 Science Drive, Madison, WI 53711) is preferentially used in place of pQE10.

Each of the polynucleotides shown in Table 1, was successfully amplified and subcloned into pQE10 as described above using the PCR primers  
30 shown in Table 3. These pQE10 plasmids containing the DNAs of Table 1, except SP023, SP042, SP054, SP063, SP081, SP092, SP114, SP122, SP123, SP126, and SP127, were deposited with the ATCC as a pooled deposit as a convenience to those of skill in the art. This pooled deposit was deposited on October 16, 1997 and given ATCC Deposit No. 209369. Those of ordinary  
35 skill in the art appreciate that isolating an individual plasmid from the pooled deposit is trivial provided the information and reagents described herein. Each of the deposited clones is capable of expressing its encoded *S. pneumoniae* polypeptide.

**Example 2: Immunization and Detection of Immune Responses****Methods****Growth of bacterial inoculum, immunization of Mice and Challenge with *S. pneumoniae*.**

Propagation and storage of, and challenge by *S. pneumoniae* are preformed essentially as described in Aaberge, I.S. et al., Virulence of *Streptococcus pneumoniae* in mice: a standardized method for preparation and frozen storage of the experimental bacterial inoculum, *Microbial Pathogenesis*, 18:141 (1995), incorporated herein by reference.

Briefly, Todd Hewitt (TH) broth (Difco laboratories, Detroit, MI) with 17% FCS, and horse blood agar plates are used for culturing the bacteria. Both broth and blood plates are incubated at 37°C in a 5% CO<sub>2</sub> atmosphere. Blood plates are incubated for 18 hr. The culture broth is regularly 10-fold serially diluted in TH broth kept at room temperature and bacterial suspensions are kept at room temperature until challenge of mice.

For active immunizations C3H/HeJ mice (The Jackson Laboratory, Bar Harbor, ME) are injected intraperitoneally (i.p.) at week 0 with 20 g of recombinant streptococcal protein, or phosphate-buffered saline (PBS), emulsified with complete Freund's adjuvant (CFA), given a similar booster immunization in incomplete Freund's adjuvant (IFA) at week 4, and challenged at week 6. For challenge *S. pneumoniae* are diluted in TH broth from exponentially-growing cultures and mice are injected subcutaneously (s.c.) at the base of the tail with 0.1 ml of these dilutions (serial dilutions are used to find medium infectious dose). Streptococci used for challenge are passaged fewer than six times *in vitro*. To assess infection, blood samples are obtained from the distal part of the lateral femoral vein into heparinized capillary tubes. A 25 ul blood sample is serially 10-fold diluted in TH broth, and 25 ul of diluted and undiluted blood is plated onto blood agar plates. The plates are incubated for 18 hr. and colonies are counted.

Other methods are known in the art, for example, see Langermann, S. et al., *J. Exp. Med.*, 180:2277 (1994), incorporated herein by reference.

### *Immunoassays*

Several immunoassay formats are used to quantify levels of streptococcal-specific antibodies (ELISA and immunoblot), and to evaluate the functional properties of these antibodies (growth inhibition assay). The ELISA and immunoblot assays are also used to detect and quantify antibodies elicited in response to streptococcal infection that react with specific streptococcal antigens. Where antibodies to certain streptococcal antigens are elicited by infection this is taken as evidence that the streptococcal proteins in question are expressed *in vivo*. Absence of infection-derived antibodies (seroconversion) following streptococcal challenge is evidence that infection is prevented or suppressed. The immunoblot assay is also used to ascertain whether antibodies raised against recombinant streptococcal antigens recognize a protein of similar size in extracts of whole streptococci. Where the natural protein is of similar, or identical, size in the immunoblot assay to the recombinant version of the same protein, this is taken as evidence that the recombinant protein is the product of a full-length clone of the respective gene.

### *Enzyme-Linked Immunosorbant Assay (ELISA).*

The ELISA is used to quantify levels of antibodies reactive with streptococcus antigens elicited in response to immunization with these streptococcal antigens. Wells of 96 well microtiter plates (Immunolon 4, Dynatech, Chantilly, Virginia, or equivalent) are coated with antigen by incubating 50  $\mu$ l of 1  $\mu$ g/ml protein antigen solution in a suitable buffer, typically 0.1 M sodium carbonate buffer at pH 9.6. After decanting unbound antigen, additional binding sites are blocked by incubating 100  $\mu$ l of 3% nonfat milk in wash buffer (PBS, 0.2% Tween 20, pH 7.4). After washing, duplicate serial two-fold dilutions of sera in PBS, Tween 20, 1% fetal bovine serum, are incubated for 1 hr, removed, wells are washed three times, and incubated with horseradish peroxidase-conjugated goat anti-mouse IgG. After three washes, bound antibodies are detected with H<sub>2</sub>O<sub>2</sub> and 2,2'-azino-di-(3-ethylbenzthiazoline sulfonate) (Schwan, T.G., *et al.*, *Proc. Natl. Acad. Sci. USA* 92:2909-2913 (1985)) (ABTS®, Kirkegaard & Perry Labs., Gaithersburg, MD) and A<sub>405</sub> is quantified with a Molecular Devices, Corp. (Menlo Park, California) Vmax™ plate reader. IgG levels twice the background level in serum from naive mice are assigned the minimum titer of 1:100.

***Sodiumdodecylsulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) and Immunoblotting***

Using a single well format, total streptococcal protein extracts or recombinant streptococcal antigen are boiled in SDS/2-ME sample buffer before electrophoresis through 3% acrylamide stacking gels, and resolving gels of higher acrylamide concentration, typically 10-15% acrylamide monomer. Gels are electro-blotted to nitrocellulose membranes and lanes are probed with dilutions of antibody to be tested for reactivity with specific streptococcal antigens, followed by the appropriate secondary antibody-enzyme (horseradish peroxidase) conjugate. When it is desirable to confirm that the protein had transferred following electro-blotting, membranes are stained with Ponceau S. Immunoblot signals from bound antibodies are detected on x-ray film as chemiluminescence using ECL™ reagents (Amersham Corp., Arlington Heights, Illinois).

***Example 3: Detection of Streptococcus mRNA expression***

Northern blot analysis is carried out using methods described by, among others, Sambrook *et al.*, *supra*, to detect the expression of the *S. pneumoniae* nucleotide sequences of the present invention in animal tissues. A cDNA probe containing an entire nucleotide sequence shown in Table 1 is labeled with <sup>32</sup>P using the *rediprime*™ DNA labeling system (Amersham Life Science), according to manufacturer's instructions. After labeling, the probe is purified using a CHROMA SPIN-100™ column (Clontech Laboratories, Inc.), according to manufacturer's protocol number PT1200-1. The purified labeled probe is then used to detect the expression of *Streptococcus* mRNA in an animal tissue sample.

Animal tissues, such as blood or spinal fluid, are examined with the labeled probe using ExpressHyb™ hybridization solution (Clontech) according to manufacturer's protocol number PT1190-1. Following hybridization and washing, the blots are mounted and exposed to film at -70 C overnight, and films developed according to standard procedures.



It will be clear that the invention may be practiced otherwise than as particularly described in the foregoing description and examples.

Numerous modifications and variations of the present invention are possible in light of the above teachings and, therefore, are within the scope of the appended claims.

5

The entire disclosure of all publications (including patents, patent applications, journal articles, laboratory manuals, books, or other documents) cited herein are hereby incorporated by reference.

Table 1

48

**SP001 nucleotide (SEQ ID NO:1)**

TAAAACTACGACAATAAAAACTCAACTCATTGCTGACTTGGGTTCTGAACGCCGCGTCAATGCCCAAGC  
TAATGATATTCCCAAGATTGGTTAAGGCAATCGTTTCTATCGAAGACCATCGCTTCTTCGACCACAG  
GGGGATTGATACCATCCGTATCCTGGGAGCTTTCTTGGCGAATCTGCAAAGCAATTCCTTCCAAGGTGG  
ATCAACTCTCACCAACAGTTGATTAAAGTTGACTTACTTTTCAACTTCGACTTCCGACCAGACTATTTTC  
TCGTAAGGCTCAGGAAGCTTGGTTAGCGATTTCAGTTAGAACAAAAAGCAACCAAGCAAGAAATCTTGAC  
CTACTATATAAATAAGGTCTACATGTCTAATGGGAAGTATGGAATGCAGACAGCAGCTCAAAACTACTA  
TGGTAAAGACCTCAATAATTTAAGTTTACCTCAGTTAGCCTTGGCTGGCTGGAATGCCTCAGGCACCAAA  
CCAATATGACCCCTATTTCATCCAGAAGCAGCCCAAGACCGCCGAACTTGGTCTTATCTGAAATGAA  
AAATCAAGGCTACATCTCTGCTGAACAGTATGAGAAAGCAGTCAATACACCAATTACTGATGGACTACA  
AAGTCTCAAATCAGCAAGTAATTACCTGCTTACATGGATAATTACCTCAAGGAAGTCATCAATCAAGT  
TGAAGAAGAAACAGGCTATAACCTACTCACAACCTGGGATGGATGCTTACACAAATGTAGACCAAGAAGC  
TCAAAAACATCTGTGGGATATTTACAATACAGACGAATACGTTGCCTATCCAGACGATGAATTGCAAGT  
CGCTTCTACCAATTGTTGATGTTTCTAACGGTAAAGTCATTGCCAGCTAGGAGCAGCCCATCAGTCAAG  
TAATGTTTCTTTCGGAATTAACCAAGCAGTAGAAACAAACCGGACTGGGGATCAACTATGAAACCGAT  
CACAGACTATGCTCCTGCTTGGAGTACGGTGTCTACGATTCAACTGCTACTATCGTTTACGATGAGCC  
CTATAACTACCCTGGGACAAATACTCCTGTTTATAACTGGGATAGGGGCTACTTTGGCAACATCACCTT  
GCAATACGCCCTGCAACAATCGCGAAACGTCAGCCGCTGGAACTCTAAACAAGGTTCGGACTCAACCG  
CGCCAAGACTTTCTTAAATGGTCTAGGAATCGACTACCCAAGTATTCCTACTCTCAAATGCCATTTCAAG  
TAACACAACCCGAATCAGACAAAAAATATGGAGCAAGTAGTGAAAAAGATGGCTGCTGCTTACGCTGCTT  
TGCAAAATGGTGAACCTTACTATAAACCAATGTATATCCATAAAGTCGCTCTTATGATGGGAGTGAAAA  
AGAGTCTCTAATGTGCGAACTCGTGCCATGAAGGAAACGACAGCCTATATGATGACCGACATGATGAA  
AACAGTCTTGACTTATGGAACCTGGACGAAATGCCTATCTTGGCTCCCTCAGGCTGGTAAAAACAGG  
AACCTCTAACTATACAGACGAGGAAATGAAACCACATCAAGACCTCTCAATTTGTAGCACCTGATGA  
ACTATTGTGCTGCTATACGCGTAAATATTCAATGGCTGTATGGACAGGCTATTCTAACCGTCTGACACC  
ACTTGTAGGCAATGGCCTTACGGTTCGCTGCCAAAGTTTACCGCTCTATGATGACCTACCTGTCTGAAGG  
AAGCAATCCAGAAGATTGGAATATACCAGAGGGGCTCTACAGAAATGGAGAAATTCGTATTTAAAAATGG  
TGCTCGTTCTACGTGGAACCTACCTGCTCCACAACAACCCCCATCAACTGAAAGTTCAAGCTCATCATC  
AGATAGTTCAACTTCACAGTCTAGCTCAACCACTCCAAGCACAAATAATAGTACGACTACCAATCTTAA  
CAATAATACGCAACAATCAATAACAACCCCTGATCAACAAAATCAGAATCCTCAACCAGCACAAACA

**SP001 AMINO ACID (SEQ ID NO:2)**

KIYDNKNQLIADLGSERRVNAQANDIPTDLVKAIVSIEDHFFDHRGIDTIRILGAFRLNLQSNLSLQGG  
STLTQQLIKLTYFSTSTSDQTI SRKAQEAWLAIQLEQKATKQEI LTYIYINKVYMSNGNYGMQTAAQNY  
GKDLNLSLPLQALLAGMPQAPNQYDPYSHPEAAQDRRLVLSEMKNGQYISAEQYKAVNPTITDGLQ  
SLKSASNPAYMDNYLKEVINQVEETGYNLLTTGMDVYTNVDQEAQKHLWDIYNTDEYVAYPDDELQV  
ASTIVDVSNKGKVIQLGARHQSSNVSFIGNAVETNRDWGSTMKPI TDYAPALEYGVYDSTATIVHDEP  
YNYPGTNTPVYNWDRGYFGNITLQYALQQSRNVPVAVETLNKVLNRAKTFNLGLGIDYPSIHYNSNAISS  
NTTESDKKYGASSEKMAAAYAAFANGGTYYKPMYIHKVVFSDGSEKEFSNVGTRAMKETTAYMMDMMK  
TVLTYGTGRNAYLAWLPQAGKTGTSNYTDEEIEENHIKTSQFVAPDELFAGYTRKYSMAVWVTGYSNRLTP  
LVGNGLTVAAKVYRSMTYLSEGSNPEDWNIPEGLYRNGEFVFKNGARSTWNSPAPQQPSTESSSSSS  
DSSTSQSSSTTPSTNNSTTTNPNNTTQSNSTTPDQONQNPQAPQ

**SP004 nucleotide (SEQ ID NO:3)**

AAATTACAATACGGACTATGAATTGACCTCTGGAGAAAAATTACCTCTTCTTAAAGAGATTTAGGTTA  
CACTTATATTGGATATATCAAAGAGGGAAAAACGACTTCTGAGTCTGAAGTAAGTAATCAAAAGAGTTC  
AGTTGCCACTCCTACAAAACAACAAAAGGTGGATTATAATGTTACACCGAATTTTGTAGACCATCCATC  
AACAGTACAAGCTATTTCAGGAACAAACACCTGTTTCTTCAACTAAGCCGACAGAAGTTCAAGTAGTTGA  
AAAACCTTTTCTTACTGAATTAATCAATCCAAGAAAAGAGAGAAACAATCTTCAGATTCTCAAGAA  
ATTAGCCGAACATAAGAATCTAGAAACGAAGAAAGAGGAGAAAGATTTCTCCAAAAGAAAAGACTGGGGT  
AAATACATTAAATCCACAGGATGAAGTTTATCAGGTCAATTGAACAAACCTGAACCTTATATCGTGGA  
GGAACTATGGAGACAAAAATAGATTTTCAAGAAGAAATTCAGAAAATCCTGATTTAGCTGAAGGAAC  
TCTAAGAGTAAACAAGAAGGTAAATAGGTAAAGAAAGTTGAAATCGTCAGAAATATTCTCTGTAAACAA  
GGAAGAAGTTTCGCGAGAAATTTGTTCAACTTCAACGACTGCGCCTAGTCCAAGAATAGTCGAAAAAGG  
TACTAAAAAACTCAAGTTATAAAGGAACAACCTGAGACTGGTGTAGAACAATAAGGACGTACAGTCTGG  
AGCTATTGTTGAACCCGCAATTCAGCCTGAGTTGCCCCGAAAGCTGTAGTAAGTGACAAAGGCGAACCA  
AGTTCAACCTACATTACCCGAAGCAGTTGTGACCGACAAAGGTGAGACTGAGGTTCAACCAGAGTCGCC  
AGATACTGTGGTAAGTGATAAAGGTGAACCAGAGCAGGTAGCACCGCTTCCAGAATATAAGGGTAAATAT

Table 1

49

TGAGCAAGTAAAACCTGAAACTCCGGTTGAGAAGACCAAAGAACAAGGTCCAGAAAAAACTGAAGAAGT  
TCCAGTAAAACCAACAGAAAGAACACCAGTAAATCCAAATGAAGGTACTACAGAAGGAACCTCAATTCA  
AGAAGCAGAAAAATCCAGTTCAACCTGCAGAAGATCAACAACGAATTCAGAGAAAGTATCACCAGATAC  
ATCTAGCAAAAATACTGGGGAAGTGTCAGTAATCCTAGTGATTTCGACAACCTCAGTTGGAGAATCAAA  
TAAACCAGAACATAATGACTCTAAAAATGAAAATTCAGAAAAAACTGTAGAAGAAGTTCAGTAAATCC  
AAATGAAGGCACAGTAGAAGGTACCTCAAATCAAGAAACAGAAAAACCAGTTCAACCTGCAGAAGAAAC  
ACAAACAACTCTGGGAAAATAGCTAACGAAAATCTGGAGAAGTATCCAATAAACCTAGTGATTCAAA  
ACCACCAGTTGAAGAATCAAATCAACCAGAAAAAACGGAAGTCAACAAAACCAGAAAATTCAGGTAA  
TACAACATCAGAGAATGGACAACAGAACCAACCAACGGAATTCAACTGAGGATGTTTCAAC  
CGAATCAAACACATCCAATTCAAATGGAACGAAGAAATTAACAAGAAAAATGAAGTACACCTGATAA  
AAAGGTAGAAGAACCAGAGAAAAACACTTGAATTAAGAAATGTTTCCGACCTAGAGTTA

**SP004 amino acid (SEQ ID NO:4)**

NYNTDYELTSGEKLPLPKEISGYTYIGYIKEGKTTSESEVSNQKSSVATPTKQKVDYNVTPNFVDHPS  
TVQAIQEQTPTSSTKPTVEVQVVEKPFSTELINPRKEEKQSSDSQEQLAEHKNLETKKEEKISPKEKTGV  
NTLNPQDEVLSGQLNKPELLYREETMETKIDFQEEIQENPDLAEGTVRVKQEGKLGKKEIVRIFSVNK  
EEVSREIVSTSTTAPSPRIVEKGTGKKTQVIKEQPETGVEHKDVQSGAIVEPAIQPELPEAVVSDKGEPE  
VQPTLPEAVVTDKGETEVQPEPDTVVSDKGEPEQVAPLPEYKGNIEQVKPETPVEKTEQGEPEKTEEV  
PVKPTTEETPVNPNEGTTEGTSIQEAENPVQPAEESTTNSEKVSPTSSKNTGEVSSNPSTSTTSVGS  
KPEHNSKKNSEKTVVEVPVNPNEGTVETSNQETEKVPQPAEETQTNSEKIANENTGEVSNKPSDSK  
PPVEESNQPEKNGTATKPNESGNTTSENGQTEPEPSNGNSTEDVSTESNTSNSNGNEEIKQENELDPDK  
KVEEPEKTLERNVSDLEL

**SP006 nucleotide (SEQ ID NO:5)**

TGAGAATCAAGCTACACCCAAAGAGACTAGCGCTCAAAAGACAATCGTCCTTGCTACAGCTGGCGACGT  
GCCACCATTTGACTACGAAGACAAGGGCAATCTGACAGGCTTTGATATCGAAGTTTAAAGGCAGTAGA  
TGAAAAACTCAGCGACTACGAGATTCAATTCAAAGAACCCTGGGAGAGCATCTTCCAGGACTTGA  
TTCTGGTCACTATCAGGCTGCGGCAATAAATCTGAGTTACACAAAAGAGCGTGTGAAAAATACCTTTA  
CTCGCTTCCAAATTTCCAACAATCCCTCGTCCTTGTCAGCAACAAGAAAAATCCTTTGACTTCTCTTGA  
CCAGATCGCTGGTAAAACAACACAAGAGGATACCGGAATCTTAACGCTCAATTCATCAATAACTGGAA  
TCAGAAACACACTGATAATCCCGCTACAATTAATTTTCTGGTGAGGATATTGGTAAACGAATCCTAGA  
CCTTGCTAACGGAGAGTTTGATTTCTAGTTTTTGACAAGGTATCCGTTCAAAAGATTATCAAGGACCG  
TGGTTTAGACCTCTCAGTCGTTGATTACCTTCTGCAGATAGCCCCAGCAATTATCATTTTCTCAAG  
CGACCAAAAAGAGTTTAAAGAGCAATTTGATAAAGCGCTCAAAGAATCTATCAAGACGGAACCTTGA  
AAAACTCAGCAATACCTATCTAGGTGTTCTTACCTCCAGATCAATCTCAGTTACAA

**SP006 amino acid (SEQ ID NO:6)**

ENQATPKETSAQKTIVLATAGDVPPFDYEDKGNLTGFDIEVLKAVDEKLSDYIEIQFORTAWESIFPGLD  
SGHYQAAANNLSYTKERAKEYLYSLPISNNPLVLVSNKNPLTSLDQIAGKTTGQEDTGTSTNAQFINNWN  
QKHTDNPATINFSGEDIGKRILDLANGEFDLVDKVSQKIIKDRGLDLSVVDLPADSPSNYIIFSS  
DQKEFKEQFDKALKELYQDGTLEKLSNTYLGGSYLPDQSQLQ

**SP007 nucleotide (SEQ ID NO:7)**

TGGTAACCGCTCTTCTCGTAACGCAGCTTCATCTTCTGATGTGAAGACAAAAGCAGCAATCGTCACTGA  
TACTGGTGGTGTGATGACAAATCATTCAACCAATCAGCTTGGGAAGGTTTGCAGGCTTGGGGTAAAGA  
ACACAATCTTTCAAAAAGATAACGGTTTCACTTACTTCCAATCAACAAGTGAAGCTGACTACGCTAACAA  
CTTGCAACAAGCGGCTGGAAGTTACAACCTAATCTTCGGTGTGGTTTTGCCCTTAATAATGCAGTTAA  
AGATGCAGCAAAAAGAACACACTGACTTGAAGTATGCTTGTGATTGATGATGTGATTAAAGACCAAAAGAA  
TGTTGCGAGCGTAACCTTCGCTGATAATGAGTCAGGTTACCTTGCAGGTGTGGCTGCAGCAAAAACAAC  
TAAGACAAAACAAGTTGGTTTTGTAGGTGGTATCGAATCTGAAGTTATCTCTCGTTTTGAAGCAGGATT  
CAAGGCTGGTGTTCGCTCAGTAGACCATCTATCAAAGTCCAAGTTGACTACGCTGGTTTCAATTTGGTGA  
TGCGGCTAAAAGGTAAAACAATTGCAGCGCACAAATACGAGCGGCTGCAGATATTGTTTACCAAGTAGC  
TGGTGGTACAGGTGCAGGTGTCTTTGCAGAGGCAAAATCTCTCAACGAAAGCCGCTCTGAAAATGAAAA  
AGTTTGGGTATCGGTGTGATCGTGACCAAGAAGCAGAAGGTAAATACACTTCTAAAGATGGCAAAGA  
ATCAAACCTTTGTTCTGTATCTACTTTGAAACAAGTTGGTACAACGTGTAAGAGATATTTCTAACAAGGC  
AGAAAGAGGAGAATTCCTGCGGCTCAAGTGATCGTTTTACTCATTGAAGGATAAAGGGTTGACTTGGC  
AGTAACAAACCTTTTCAAGAAGGTAAGGTAAGGTCGAGATGCAAAAGCTAAATCCTTGATGGAAG  
CGTAAAAGTTCTTGAAAAA

Table 1

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**SP007 amino acid (SEQ ID NO:8)**

GNRSSRNAASSSDVKTAAIVTDTGGVDDKSFNQSAWEGLQAWGKEHNLSKDNGFTTYFQSTSEADYANN  
 LQQAAGSYNLIIFGVGFALNNNAVDAAKEHTDLNLYVLIDDVIKQKNVASVTFADNESGYLAGVAAAKTT  
 KTKQVGFVGGIESEVISRFEAGFKAGVASVDPSIKVQVDYAGSFGDAAKGKTIAAAQYAAGADIVYQVA  
 GGTGAGVFAEAKSLNESRPENЕКVWVIGVDRDQEAEGKYTSKDГKESNFVLVSTLKQVGTTVKDISNKA  
 ERGEFPGGQVIVYSLKDKGVDLAVTNLSEEGKKAVEDAKAILDGSVKVPEK

**SP008 nucleotide (SEQ ID NO:9)**

TGTGGAATTTGACAGGTAACAGCAAAAAGCTGCTGATTGAGGTGACAAACCTGTTATCAAAATGTAC  
 CAAATCGGTGACAAACCAGACAACCTGGATGAATTTGTAGCAAATGCCAACAAAATCATTGAAGAAAAA  
 GTTGGTGCCAAATTTGGATATCCAATACCTTGGCTGGGGTGACTATGGTAAGAAAATGTCAGTTATCACA  
 TCATCTGGTGAAAACATATGATATTGCCTTTGCAGATAACTATATTGTAATGCTCAAAAAGGTGCTTAC  
 GCTGACTTGACAGAATTGTACAAAAAAGAGGTAAAGACCTTTACAAAGCACTTGACCCAGCTTACATC  
 AAGGGTAATACGTAAATGGTAAGATTTACGCTGTTCCAGTTGCAGCCAACGTTGCATCATCTCAAAAC  
 TTTGCCTTCAACCGAAGCTCTCCTTGCTAAATATGGTATCGATATTTCAAGGTGTACTTCTTACGAAACT  
 CTTGAGCCAGTCTTGAAACAAATCAAAAGAAAAAGCTCCAGACGTAGTACCATTGCTATTGGTAAAGTT  
 TTCATCCCATCTGATAATTTTGACTACCCAGTAGCAAACGGCTTCCATTGCTTATCGACCTTGAAGGC  
 GATACTACTAAAGTTGTAACCGTTACGAAGTGCCTCGTTTCAAAGAACACTTGAAGACTCTTCACAAA  
 TTCTATGAAGCTGGCTACATTCCAAAAGACGTCGCAACAAGCGATACTTCTTTGACCTTCAACAAGAT  
 ACTTGGTTTCGTTTCGTAAGAAACAGTAGGACAGCTGACTACGGTAACAGCTTGCTTTACGTTGTCG  
 AACAAAGATATCCAAATCAAACCAATTACTAACTTCATCAAGNAAAACCAACAACACAGATTGCTAAC  
 TTTGTCATCTCAAACAACCTTAAGAACAAGAAAAATCAATGGAAATCTTGAACCTCTTGAATACGAAC  
 CCAGAACTCTTGAACGGTCTTGTTCGCTCCAGAAGGCAAGAACTGGGAAAAAATTGAAGGTAAAGAA  
 AACCCTGTTTCGCTTCTTGATGGCTACAAAGGAAACACTCACATGGGTGGATGGAACACTGGTAACAAC  
 TGGATCCTTTACATCAACGAAAACGTTACAGACCAACAAATCGAAAATCTAAGAAAGAATTGGCGAGAA  
 GCTAAAGAATCTCCAGCGCTTGGATTTATCTTCAATACTGACAATGTGAAATCTGAAATCTCAGCTATT  
 GCTAACACAATGCAACAATTTGATACAGCTATCAACACTGGTACTGTAGACCCAGATAAAGCGATTCCA  
 GAATTGATGGAAAAATTGAAATCTGAAGGTGCCTACGAAAAAGTATTGAACGAAATGCAAAAACAATAC  
 GATGAATCTTGA AAAACAAAAA

**SP008 amino acid (SEQ ID NO:10)**

CGNLTGNSKKAADSGDKPVIKMYQIGDKPDNLDELLANANKIIIEKVGAKLDIQYLGWGDYGKKMSVIT  
 SSGENYDIAFADNYIVNAQKGAYADLTLEYKKEGKDYKALDPAYIKGNTVNGKIYAVPVAANVASSQN  
 FAFNGTLLAKYIDISGVTSEYETLEPVLKQIKEKAPDVVPFAIGKVFIPSDNFDYPVANGLPFVIDLEG  
 DTTKVNVRYEVPFRKEHLKTLHKFYEAGYIPKDVATSDTSFDLQDQDWFVREETVGPADYGNLSLLSRVA  
 NKDIQIKPITNFIKXNQTTQVANFVISNNSKNKEKSMEILNLLNTNPELLNGLVYGPPEGKNWEKIEGKE  
 NRVRLDGYKGNTHMGWNTGNNWILYINENVTDQIENSKKELAEAKESPALGFI FNTDNVКSEISAI  
 ANTMQQFDTAINTGTVDPKAIPELMEKLLKSEGAYEKVLNEMQKQYDEFLKNKK

**SP009 nucleotide (SEQ ID NO:11)**

TGGTCAAGGAAGTCTTCTAAAGACAACAAAGAGGCAGAACTTAAGAAGGTTGACTTTATCCTAGACTG  
 GACACCAAATACCAACCACACAGGGCTTTATGTTGCCAAGGAAAAAGGTTATTTCAAAGAAGCTGGAGT  
 GGATGTTGATTTGAAATTGCCACCAGAAGAAAGTTCTTCTGACTTGGTTATCAACGGAAAGGCACCAT  
 TGCAGTGATTTTCCAAGACTACATGGCTAAGAAATTTGAAAAAGGAGCAGGAATCACTGCCGTTGCAGC  
 TATTGTTGAACACAATACATCAGGAATCATCTCTCGTAAATCTGATAATGTAAGCAGTCCAAAAGACTT  
 GGTGTTGAAGAAATATGGGACATGGAATGACCCAACCTGAACCTTGCTATGTTGAAAACCTTGGTAGAATC  
 TCAAGGTGGAGACTTTGAGAAGGTTGAAAAAGTACCAAATAACGACTCAAACCTCAATCACACCGATTGC  
 CAATGGCGTCTTTGATACTGCTTGGATTTACTACGGTTGGGATGGTATCCTTGCTAAATCTCAAGGTGT  
 AGATGCTAACTTCATGTACTTGAAAGACTATGTCAAGGAGTTTGACTACTATTACCAGTTATCATCGC  
 AAACAACGACTATCTGAAAGATAACAAAGAAGAAGCTCGCAAAGTCATCCAAGCATCAAAAAAGGCTA  
 CCAATATGCCATGGAACATCCAGAAGAAGCTGCAGATATTCTCATCAAGAATGCACCTGAACCTCAAGGA  
 AAAACGTGACTTTGTATCGAATCTCAAAAATACTTGTCAAAAGAATACGCAAGCGACAAGGAAAAATG  
 GGGTCAATTTGACGAGCTCGCTGGAATGCTTCTACAAATGGGATAAAGAAAAATGGTATCCTTAAAGA  
 AGACTTGACAGACAAAGGCTTCACCAACGAATTTGTGAAA

**SP009 amino acid (SEQ ID NO:12)**

Table 1

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GQGTASKDNKEAELKKVDFILDWTPNTNHTGLYVAKEKGYFKEAGVDVLDLKLPPPESSSDLVINGKAPF  
 AVYFQDYMAKKLEKAGITAVAAIVEHNTSGIISRKSDNVSSPKDLVGKKYGTWNDPTELAMLKTLVES  
 QGGDFEKVEKVPNNDSNSITPIANGVFDTAWIYYGWDGILAKSQGV DANFMYLKDYVKEFDYYSPIVIA  
 NNDYLKDNKEEARKVIAIKKGYQYAMEHPPEEAADILIKNAPELKEKRFVIESQKYLSEYASDKEKW  
 GQFDAARWNAFYKWDKENGILKEDLTDKGFTNEFVK

**SP010 nucleotide (SEQ ID NO:13)**

TAGCTCAGGTGGAACGCTGGTTCATCCTCTGGAAAAACAACCTGCCAAAGCTCGCACTATCGATGAAAT  
 CAAAAAAGCGGTGAACCTGCGAATCGCCGTGTTGGAGATAAAAAACCGTTGGCTACGTTGACAATGA  
 TGGTTCTACCAAGGTACGCTACGATATTGAACTAGGGAACCAACTAGCTCAAGACCTTGGTGTCAAGGT  
 TAAATACATTTAGTCGATGCTGCCAACCGTGCAGTAATCTTGAATTTCAAACAAGGTAGATATTACTCT  
 TGCTAACTTTACAGTAACTGACGAACGTAAGAAACAAGTTGATTTTGCCCTTCCATATATGAAAGTTTC  
 TCTGGGTGTCGTATCACCTAAGACTGGTCTCATTACAGACGTCAAACAACCTGAAGGTAACCTTAAT  
 TGTCAAAAAGGAACGACTGCTGAGACTTATTTGAAAAGAAATCATCCAGAAATCAAACCTCAAAAAATA  
 CGACCAATACAGTGACTCTTACCAAGCTCTTCTTGACGGACGTGGAGATGCCCTTTTCAACTGACAATAC  
 GGAAAGTTCTAGCTTGGGCGCTTGAAAATAAAGGATTGGAAGTAGGAATTACTTCCCTCGGTGATCCCGA  
 TACCATTGCGGCAGCAGTTCAAAAAGGCAACCAAGAATTGCTAGACTTCATCAATAAAGATATTGAAAA  
 ATTAGGCAAGGAAAACCTTCTCCACAAGGCCTATGAAAAGACACTTCACCCAACCTACGGTGACGCTGC  
 TAAAGCAGATGACCTGGTTGTTGAAGGTGGAAGGTTGAT

**SP010 amino acid (SEQ ID NO:14)**

SSGGNAGSSSGKTTAKARTIDEIKSGELRIAVFGDKKPFYVDNDGSTKVRDYDIELGNQLAQDLGVKV  
 KYISVDAANRAEYLI SNKVDITLANFTVTDERRKQVDFALPYMKVSLGVVSPKTLITDVQLEGKTLI  
 VTKGTTAETVFEKNHPEIKLQKYDQYSDSYQALLDGRGDAFSTDNTEVLAWALENKGFVGGITSLGDGP  
 TIAAAVQKGNQELDLINKDIEKLGKENFFHKAYEKTLLHPTYGDAAKADDLVVEGGKVD

**SP011 nucleotide (SEQ ID NO:15)**

CTCCAACTATGGTAAATCTGCGGATGGCACAGTGACCATCGAGTATTTCAACCAGAAAAAGAAATGAC  
 CAAAACCTTGAAGAAATCACTCGTGATTTTGAAGAGAAAACCTAAGATCAAGGTCAAAGTCCGTCAA  
 TGTACCAATGCTGGTGAAGTATTGAAGACACGCGTTCTCGCAGGAGATGTGCCTGATGTGGTCAATAT  
 TTACCACAGTCCATCGAAGTGAAGAAATGGGCAAAAAGCAGGTGTTTGAAGATTGAGCAACAAGA  
 CTACCTGAAACGCGTGAAAAATGGCTACGCTGAAAAATATGCTGTAAACGAAAAAGTTTACAACGTTCC  
 TTTTACAGCTAATGCTTATGGAATTTACTACAACAAAGATAAATTCGAAGAACTGGGCTTGAAGGTTCC  
 TGAAACCTGGGATGAATTTGAACAGTTAGTCAAAGATATCGTTGCTAAAGGACAAACACCATTTGGAAT  
 TGCAGGTGCAGATGCTTGGACACTCAATGGTTACAATCAATTAGCCTTTGCGACAGCAACAGGTGGAGG  
 AAAAGAGCAAAATCAATACCTTCGTTATTTCTCAACCAAAATGCCATTAAATGTGCGATCCGATTATGAA  
 AGATGATATCAAGGTCAATGACATCCTTCGCATCAATGGATCTAAGCAAAAAGAACTGGGAAGGTGCTGG  
 CTATACCGATGTTATCGGAGCCTTCGCACGTGGGGATGTCTCATGACACCAAAATGGGCTTTGGGCGAT  
 CACAGCGATTAATGAACAAAAACCGAACTTTAAGATTGGGACCTTCATGATTCCAGGAAAAAGAAAAAGG  
 ACAAAGCTTAACCGTTGGTGCGGAGACTTGGCATGGTCTATCTCAGCCACCACCAACATCCAAAAGA  
 AGCCAAATGCCTTTGTGGAATATATGACCCGTCAGAAAGTCATGCAAAAATACTACGATGTGGACGGATC  
 TCCAACAGCGATCGAAGGGGTCAAACAAGCAGGAGAAGATTCAACCGCTTGCTGGTATGACCGAATATGC  
 CTTTACGGATCGTCACTTGGTCTGGTTGCAACAATACTGGACCAAGTGAAGCAGACTTCCATACCTTGAC  
 CATGAATATGTCTTGACCGGTGATAACAAGGCATGGTCAATGATTGGAATGCCCTCTTTAACCAGAT  
 GAAAGCGGATGTGGAT

**SP011 amino acid (SEQ ID NO:16)**

SNYKSGADGTVTIEYFNQKKEMTKLEEITRDFEKENPKIKVKNVNPAGEVLKTRVLADGVPDVVNI  
 YPQSIELQEWAKAGVFEDLSNKDYLRVKNKYAEKYAVNEKYNVNPFTANAYGIYNNKDKFEELGLKVP  
 ETWDFEQLVKDIVAKGQTPFGIAGADAWTLNGYNQLAFATATGGGKEANQYLRYSPNAIKLSDPIMK  
 DDIKVMDILRINGSKQKNWEGAGYTDVIGAFARGDVLMTPNGSWAITAINEQKPNFKIGTFMIPGKEKG  
 QSLTVGAGDLAWSISATTKHPKEANAFVEYMTREPMQKYVDVGSPTAIEGVKQAGEDSPLAGMTEYA  
 FTDRHLVLWQQYWTSEADFHTLTMNYVLTGDKQGMVNDLNAFFNPMKADVD

**SP012 nucleotide (SEQ ID NO:17)**

TGGGAAAAATCTAGCGAACTAGTGAGATAATTGGTCAAAGTACCAGTCTAACAAGTCTATTACTAT  
 TGGATTTGATAGTACTTTTGTTCATGGGATTTGGCTCAGAAAGATGGTCTTATGCAGGATTTGATAT  
 TGATTTAGCTACAGCTGTTTTTGAAAAATACCGAATCAGGTAATTTGGCAACCGATTGATTGGGATTT

Table 1

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GAAAGAAGCTGAATTGACAAAAGGAACGATTGATCTGATTGGAATGGCTATTCCGCTACAGACGAACG  
CCGTGAAAAGGTGGCTTTCAGTAACTCATATATGAAGAATGAGCAGGTATTGGTTACGAAGAAATCATC  
TGGTATCACGACTGCAAAAGGATATGACTGGAAAGACATTAGGAGCTCAAGCTGGTTTCATCTGGTTATGC  
GGACTTTGAAGCAAAATCCAGAAATTTTGAAGAATATTGTCGCTAATAAGGAAGCGAATCAATACCAAAC  
CTTTAATGAAGCCTTGATTGATTGAAAAACGATCGAATTGATGGTCTATTGATTGACCGTGTCTATGC  
AAACTATTATTTAGAAGCAGAAGGTGTTTAAACGATTATAATGTCTTTACAGTTGGACTAGAAACAGA  
AGCTTTTGCGGTTGGAGCCCGTAAGGAAGATACAACTTGGTTAAGAAGATAAATGAAGCTTTTTCTAG  
TCTTTACAAGGACGGCAAGTTCCAAGAAATCAGCCAAAAATGGTTTGGAGAAGATGTAGCAACCAAGA  
AGTAAAAGAAGGACAG

**SP012 nucleotide (SEQ ID NO:18)**

GKNSSETSGDNWSKYQSNKSITIGFDSTFVPMGFAQKDGSYAGFDIDLATAVFEKYGITVNWQPIDWDL  
KEAELTKGTIDLIWNGYSATDERREKVAFSNSYMKNEQVLVTKKSSGITAKDMTGKTLGAQAGSSGYA  
DFEANPEILKNIVANKEANQYQTFNEALIDLKNDRIDGLLIDRVYANYYLEAEGVLNDYNVFTVGLETE  
AFAVGARKEDTNLVKKINEAFSSLYKDGKFQEIISQKWFGEVDATKEVKEGQ

**SP013 nucleotide (SEQ ID NO:19)**

TGCTAGCGGAAAAAAGATACAACCTCTGGTCAAAAACATAAAGTTGTTGCTACAAAACCAATCATCGC  
TGATATTACTAAAAATATTCCTGGTGACAAAATTGACCTTCATAGTATCGTTCCGATTGGGCAAGACCC  
ACACGAATACGAACCACTTCCTGAAGACGTTAAGAAAACCTCTGAGGCTAATTTGATTTCTATAACGG  
TATCAACCTTGAACACAGGTGGCAATGCTTGGTTTACAAAATTGGTAGAAAATGCCAAGAAAACGAAAA  
CAAAGACTACTTCGCAGTCAGCGACGGCGTTGATGTTATCTACCTGAAGGTCAAAATGAAAAGGAAA  
AGAAGACCCACACGCTTGGCTTAACCTTGAACCGGTATTATTTTGTAAAAATATCGCCAAACAATT  
GAGCGCCAAAGACCTTAACAATAAAGAAATCTATGAAAAAATCTCAAAGAATATACTGATAAGTTAGA  
CAAACCTTGATAAAGAAAGTAAGGATAAAATTAATAAGATCCCTGCTGAAAAGAACTCATTTGAACCAG  
CGAAGGAGCATTCAAATACTTCTCTAAAGCCTATGGTGTCCCAAGTGCTTACATCTGGGAAATCAATAC  
TGAAGAAGAAGGAACCTCTGAACAAATCAAGACCTTGGTTGAAAAACCTCGCCAAACAAAAGTTCCATC  
ACTCTTTGTAGAATCAAGTGTGGATGACCGTCCAATGAAAACGTGTTTCTCAAGACACAAACATCCCAAT  
CTACGCTCAAATCTTACTGACTCTATCGCAGAACAAGGTAAAGAAGGCGACAGTACTACAGCATGAT  
GAAATACAACCTTGACAAGATTGCTGAAGGATTGGCAAAA

**SP013 amino acid (SEQ ID NO:20)**

ASGKDDTSGQKLKVATNSIIADITKNIAGDKIDLHSIVPIGQDPHEYEPLPEDVKKTSEANLIFYNG  
INLETGGNAWFTKLVENAKKTENKDYFAVSDGVDVIYLEGQNEKGKEDPHAWLNLENGIIFAKNIAKQL  
SAKDPNNKEFYEKNLKEYTDKLDKDKESKDFNKIPAEEKLIVTSEGAFFKYFSKAYGVPSAYIWEINT  
EEEGTPEQIKTLVEKLRQTKVPSLFVSSVDDRPMKTVSQDTNIPYAIQIFTDSIAEQGKEGDSYYSMM  
KYNLDKIAEGLAK

**SP014 nucleotide (SEQ ID NO:21)**

TGGCTCAAAAAATACAGCTTCAAGTCCAGATTATAAGTTGGAAGGTGTAACATTCCTCGCTTCAAGAAAA  
GAAAACATTGAAGTTTATGACAGCCAGTTCACCGTTATCTCCTAAAGACCCAAATGAAAAGTTAATTTT  
GCAACGTTTGGAGAAGGAACTGGCGTTTCATATTGACTGGACCAACTACCAATCCGACTTTGCAGAAAA  
ACGTAACCTTGGATATTCTAGTGGTGATTACCAGATGCTATCCACAACGACGGAGCTTCAGATGTGGA  
CTTGATGAAGTGGCTAAAAAAGGTGTTATTATTCAGTTGAAGATTGATTGATAAATACATGCCAAA  
TCTTAAGAAAAATTTGGATGAGAAACCAGAGTACAAGGCCCTTGATGACAGCACCTGATGGGCACATTTA  
CTCATTTCCATGGATTGAAGAGCTTGGAGATGGTAAAGAGTCTATTACAGTGTCAACGATATGGCTTG  
GATTAACAAAGATTGGCTTAAGAACTTGGTCTTGAAATGCCAAAAACTACTGATGATTTGATTAAAGT  
CCTAGAAGCTTTCAAAAACGGGGATCCAAATGGAAATGGAGAGGCTGATGAAATTCATTTTCATTAT  
TAGTGGTAACGGAAACGAAGATTTTAAATTCCTATTGCTGCATTTGGTATAGGGGATAACGATGATCA  
TTTAGTAGTAGGAAATGATGGCAAAGTTGACTTCACAGCAGATAACGATAACTATAAAGAAGGTGTCAA  
ATTTATCCGTCAATTGCAAGAAAAAGGCTGATGTGATAAAGAAGCTTTCGAACATGATTGGAATAGTTA  
CATTGCTAAAGGTCATGATCAGAAATTTGGTGTACTTTACATGGGATAAGAATAATGTTACTGGAAG  
TAACGAAAGTTATGATGTTTTACCAGTACTTGGTGGACCAAGTGGTCAAAAACACGTAGCTCGTACAAA  
CGGTATGGGATTTGCACGTGACAAGATGGTTATTACCAGTGTAACAAAAACCTAGAATTGACAGCTAA  
ATGGATTGATGCACAATACGCTCCACTCCAATCTGTGCAAAAATACTGGGGAACCTACGGAGATGACAA  
ACAACAAAACATCTTTGAATTGGATCAAGCGTCAAATAGTCTAAAACACTTACCCTAAACGGAACCTGC  
ACCAGCAGAATCTCGTCAAAAGACTGAAGTAGGAGGACCACTAGCTATCCTAGATTCTACTATGGTAA  
AGTAACAACCATTCCTGATGATGCCAAATGGCGTTTGGATCTTATCAAAGAATATTATGTTCTTACAT

Table 1

GAGCAATGTCAATAACTATCCAAGAGTCTTTATGACACAGGAAGATTGGACAAGATTGCCCATATCGA  
AGCAGATATGAATGACTATATCTACCGTAAACGTGCTGAATGGATTGTAAATGGCAATATTGATACTGA  
GTGGGATGATTACAAGAAAGAACTTGAAAAATACGGACTTTCTGATTACCTCGCTATTAACAAAAATA  
CTACGACCAATACCAAGCAAAACAAAAAC

**SP014 amino acid (SEQ ID NO:22)**

GSKNATSSPDYKLEGVTFPLQEKTLKFMTASSPLSPKDPNEKLILQRLKETGVHIDWTNYQSDFAEK  
RNLDISSGDLPDALHNDGASDVLMNWAKKGVIIIPVEDLIDKYPNLKKILDEKPEYKALMTAPDGHIIY  
SFFWIEELGDGKESIHVSNDMAWINKDWLKKLGLEMPKTTDDLIKVLEAFKNGDPNGNGEADIEIPFSFI  
SGNGNEDFKFLFAAFGIGDNDHLVVGNDGKVDFTADNDNYKEGVKFIQRLQEKGLIDKEAFEHDWNSY  
IAKGHDQKFGVYFTWDKNNVTGSNESYDVLVLAGPSGQKHVARTNGMGFARDKMVITSVNKNLELTAK  
WIDAQYAPLQSVQNNWGTGDDKQKNIFELDQASNSLKHLPNGTAPAE LRQKTEVGGPLAILDSSYVGK  
VTMPDDAKWRDLIKEYVYPYMSNVNNYPRVFTQEDLDKIAHIEADMNDYIYRKRAEWIVNGNIDTE  
WDDYKKELEKYGLSDYLAIKQKYDQYQANKN

**SP015 nucleotide (SEQ ID NO:23)**

TAGTACAAACTCAAGCACTAGTCAGACAGAGACCAGTAGCTCTGCTCCAACAGAGGTAACCATTAAGG  
TTCACTGGACGAGGTCAAACCTTTCCAAAGTTCTTGAAAGATTGTGACCTTTGACCTCGGCGCTGCGGA  
TACTATTCGCGCTTTAGGATTTGAAAAAATATCGTCGGAATGCCTACAAAAACTGTTCCGACTTATCT  
AAAAGACCTAGTGGGAACGTCAAAAATGTTGGTTCTATGAAAGAACCCTGATTTAGAAGCTATCGCCGC  
CCTTGAGCCTGATTTGATTATCGCTTCGCCACGTACACAAAAATTCGTAGACAAATTCAAAGAAATCGC  
CCCAACCGTTCTCTTCCAAGCAAGCAAGGACGACTACTGGACTTCTACCAAGGCTAATATCGAATCCTT  
AGCAAGTGCCTTCGGCGAAACTGGTACACAGAAAGCCAAGGAAGAATTGACCAAGCTAGACAAGAGCAT  
CCAAGAAGTCGCTACTAAAAATGAAAGCTCTGACAAAAAAGCCCTTGCGATCCTCCTTAATGAAGGAAA  
AATGGCAGCCTTTGGTGCCAAATCTCGTTTCTCTTCTGTACCAAACTTTGAAATTCAAACCACTGA  
TACAAAAATTGAAAGACTCACGCCACGGACAAGAAAGTCAGCTTTGAAAGTGTCAAAGAAATCAACCTGA  
CATCCTCTTTGTATCAACCGTACCTTGGCATCGGTGGGACAACTCTAGCAACGACGGTGTCTAGTA  
AAATGCCCTTATCGCTGAAACACCTGCTGCTAAAAATGGTAAGATTATCCAACCTAACACCGACCTCTG  
GTATCTAAGCGGAGGCGGACTTGAATCAACAAAACTCATGATTGAAGACATACAAAAAGCTTTGAAA

**SP015 amino acid (SEQ ID NO:24)**

STNSSTSQETETSSSAPEVTIKSSLDEVKLSKVPEKIVTFDLGAADTIRALGFENIVGMPTKTVPTYL  
KDLVGTGTVKNVGSMPKPDLEAIALEPDIIASPRTQKFVDKFEIAPTFLVQASKDDYWTSTKANIESL  
ASAFGETGTQKAKEELTKLDSIQEVATKNESDKKALAILNEGKMAAFGAKSRFSFLYQTLKFKPTD  
TKFEDSRHQEVFSFESVKEINPDILFVINRTLAIGGDNSSNDGVLENALIAETPAAKNGKIIQLTPDLW  
YLSGGGLESTKLMIEDIQKALK

**SP016 nucleotide (SEQ ID NO:25)**

TGGCAATTCTGGCGGAAGTAAAGATGCTGCCAAATCAGGTGGTGACGGTGCCAAAAACAGAAATCACTTG  
GTGGGCATTTCCAGTATTTACCCAAGAAAAAAGTGGTGACGGTGTGGAACCTATGAAAAATCAATCAT  
CGAAGCGTTTAAAAAGCAAACCCAGATATAAAAAGTAAATGGAAACCATCGACTTCAAGTCAGGTCC  
TGAAAAATCACAAACAGCCATCGAAGCAGGAACAGCTCCAGACGTAATCTTTGATGCACAGGACGTAT  
CATCCAATACGGTAAAAACGGTAAATGGCTGAGTTGAATGACCTCTTCACAGATGAATTTGTTAAAGA  
TGTCACAAATGAAAAATCGTACAAGCAAGTAAAGCTGGAGACAAGGCTTATATGTATCCGATTAGTTC  
TGCCCCATTTCTACATGGCAATGAACAAGAAAAATGTTAGAAGATGCTGGAGTAGCAACCTTGTAAAAGA  
AGGTTGGACAACCTGATGATTTTAAAAAGTATGAAAGCACTTAAAGACAAGGGTTACACACCAGGTTT  
ATTGTTCACTTCTGGTCAAGGGGAGACCAAGGAACACGTGCCTTTATCTCTAACCTTTATAGCGGTTT  
TGTAACAGATGAAAAAGTTAGCAAAATATCAACTGATGATCCTAAATTCGTCAAAGGTCTTGAAAAAGC  
AACTAGCTGGATTAAAGACAATTTGATCAATAATGGTTCACAATTTGACGGTGGGGCAGATATCCAAAA  
CTTTGCCAACGGTCAAACATCTTACACAATCCTTTGGGCACCAAGCTCAAAATGGTATCCAAGCTAACT  
TTTAGAAGCAAGTAAGGTAGAAGTGGTAGAAGTACCATTCCCATCAGACGAAGGTAAGCCAGCTCTTGA  
GTACCTTGTAACCGGTTTGCAGTATTCACAAATAAGACGACAAGAAAGTCGCTGCATCTAAGAAAT  
CATCCAGTTTATCGCAGATGACAAGGAGTGGGGACCTAAAGACGTAGTTTCGTACAGGTGCTTTCCAGT  
CCGTACTTCAATTTGGAAAACTTTATGAAGACAAACGCATGGAACAATCAGCGGCTGGACTCAATACTA  
CTCACCATACTACAACACTATTGATGGATTGCTGAAATGAGAACACTTTGGTTCCCAATGTTGCAATC  
TGTAATCAAAATGGTGACGAAAAACCAAGAGATGCTTTGAAAGCCTTCACTGAAAAAGCGAACGAAACAA  
CAAAAAAGCTATGAAACAA

Table 1

**SP016 amino acid (SEQ ID NO:26)**

GNSGGSKDAAKSGGDGAKTEITWWAFPVFTQEKTDGTVGTYEKSIIIEAFEKANPDIKVKLETIDFKSGP  
 EKITTAIEAGTAPDVLFDAPGRIIQYKNGKLAELNDFLTFDEFKVDVNNENIVQASKAGDKAYMYPIS  
 APFYMANMKMLEDAGVANLVKEGWTTDDFEKVLKALKDKGYTPGSLFSSGQGGDQGTAFISNLYSGS  
 VTDEKVSKEYTTDDPKFVKGLEKATSWIKDNLINNGSQFDGGADIONFANGQTSYTIWAPAQNGIQAKL  
 LEASKVEVVEVPFSPDEGKPALEYLVNGFAVFNNKDDKKVAASKKFIQFIADDEKWEKPDVVRTGAFPV  
 RTSFGKLYEDKRMETISGWTQYYSPIYNTIDGFAEMRTLWFPMLQSVSNGDEKPADALKAFTEKANETI  
 KKAMKQ

**SP017 nucleotide (SEQ ID NO:27)**

TTCACAAGAAAAACAAAAATGAAGATGGAGAACTAAGACAGAACAGACAGCCAAAGCTGATGGAAC  
 AGTCGGTAGTAAGTCTCAAGGAGCTGCCCGAGAAAGCAGAAAGTGGTCAATAAAGGTGATTACTACAG  
 CATTCAAGGGAAATACGATGAAATCATCGTAGCCAAACAACTATCCATTGTCTAAAGACTATAATCC  
 AGGGGAAAAATCCAACAGCCAAGGCAGAGTTGGTCAAACCTCATCAAAGCGATGCAAGAGGCAGGTTCC  
 TATTAGTGATCATACAGTGGTTTTAGAAAGTTATGAACTCAGACCAAGCTCTATCAAGATTATGTCAA  
 CCAAGATGGAAAGGCAGCAGCTGACCGTTACTCTGCCCCGCTCTGGCTATAGCGAACACCAGACAGGCTT  
 GGCCTTTGATGTGATTGGGACTGATGGTGATTTGGTGACAGAAGAAAAAGCAGCCCAATGGCTCTTGGA  
 TCATGCAGCTGATATGGCTTTGTGTCCGTTATCTCAAAGGCAAGGAAAAGGAAACAGGCTATATGGC  
 TGAAGAAATGGCACCTGCGTTATGTAGGAAAAGAAGCTAAAGAAATTTGCTGCAAGTGGTCTCAGTTTGA  
 AGAATACTATGGCTTTGAAGGCGGAGACTACGTCGAT

**SP017 amino acid (SEQ ID NO:28)**

SQEKTKNEDGETKTEQTAKADGTGSGSKSQGAAQKKADEVNKGDYYSIQGKYDEIIVANKHYPLSKDYNP  
 GENPTAKAELVKLIKAMQEAGFPISDHYSGRFSYETQTKLYQDYVNQDGKAAADRYRSARPGYSEHQ  
 TGLAFDVIQDGLDTEKAAQWLLDHAADYGFVVRVYLGKKEKETGYMAEEWHLRYVGKEAKEIAASGLSLE  
 EYYGFEGGDYVD

**SP019 nucleotide (SEQ ID NO:29)**

GAAAGGTCTGTGGTCAAATAATCTTACCTGCGGTTATGATGAAAAATAATCTTGAAAAATATAAATAT  
 AAAAAATACCTGAAGAAAAAATATCAGTTATTATTGGGTCAAATGGTTGTGGGAAATCAACACTCATTA  
 AACCTTGCTCGACTTATAAGCCATTAGAGGGAGAAGTATTGCTTGATAATAATCAATTAATCTTTA  
 TAAAGAAAAAGATTAGCAAAACACATAGCTATATTACCTCAATCTCCAATAATCCCTGAATCAATAAC  
 AGTAGCTGATCTTGTAAGCCGTGGTCGTTTCCCTACAGAAAGCCTTTTAAGAGTCTTGAAAAAGATGA  
 CCTTGAAATAATAACAGATCAATGGTTAAGGCCAATGTTGAAGATCTAGCAAATAACCTAGTTGAAGA  
 ACTTTCTGGGGGTCAAAGGCAAAGAGTATGGATAGCTCTAGCCCTAGCCCAAGATACAAGTATCCTACT  
 TTTAGATGAGCCAACTACTTACTTGGATATCTCATATCAAATAGAACTATTAGACCTCTTGACTGATCT  
 AAACCAAAAAATAAGACAACCATTTGCATGATTTTGCACGATATAAATCTAACAGCAAGATACCGTGA  
 TTACTTATTTGCAATTAAAGAAGGTAAACTTGTTCAGAGGGAAAGCCTGAAGATATACTAAATGATAA  
 ACTAGTTAAAGATATCTTTAATCTTGAAGCAAAAATTATACGTGACCCTATTTCCAATTCGCCTCTAAT  
 GATTCTTATTGGCAAGCACCATTGTTAACTCT

**SP019 amino acid (SEQ ID NO:30)**

KGLWSNNLTCGYDEKIILENINIKIPEEKISVIIGSNCGKSTLIKTLRLIKPLEGEVLLDNKSINSY  
 KEKDLAKHIAILPQSPPIIPESITVADLVSRGRFPYRKPKSLGKDDLEIINRSMVKANVEDLANNLVEE  
 LSGGQRQRVWIALALAQDTSILLDEPTTYLDISYQIELDLLDLNQQYKTTICMILHDINLTARYAD  
 YLFAIKEGKLVAEGKPEDILNDKLVKDI FNLEAKIIRDPISNSPLMIPIGKHHVS

**SP020 nucleotide (SEQ ID NO:31)**

AAACTCAGAAAAGAAAGCAGACAATGCAACAACTATCAAAATCGCAACTGTTAACCGTAGCGGTTCTGA  
 AGAAAAACGTTGGGACAAAATCCAAGAATTGGTTAAAAAAGACGGAAATTACCTTGGAATTACAGAGTT  
 CACAGACTACTCACAACCAAAACAAAGCAACTGCTGATGGCGAAGTAGATTGAAACGCTTTCCAACACTA  
 TAACCTTCTGAACTGGAACAAAGAAAACGAAAAAGACCTTGTAGCGATTGCAGATACTTACATCTC  
 TCCAATCCGCCTTTACTCAGGTTTGAATGGAAGTGCCAACAAGTACACTAAAGTAGAAGACATCCCAGC  
 AAACGGAGAAATCGCTGTACCGAATGACGCTACAAACGAAAGCCGTGCGCTTTATTTGCTTCAATCAGC  
 TGGCTTGATTAATTTGGATGTTTCTGGAACGTCTTGTCAACAGTTGCCAACATCAAAGAAAATCCAAA  
 GAACCTGAAAATCACTGAATTGGACGCTAGCCAAACAGCTCGTTCAATGTCATCAGTTGACGCTGCCGT  
 GTGAAACAATACCTTCGTTACAGAAGCAAAATGGACTACAAGAAATCACTTTTCAAAGAACAAGCTGA  
 TGAAAACCTCAAAACAATGGTACAACATCATTGTTGCAAAAAAAGATTGGGAAACATCACCTAAGGCTGA



## Tabl 1

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TGCTATCAAGAAAGTAATCGCAGCTTACCACACAGATGACGTGAAAAAAGTTATCGAAGAATCATCAGA  
TGGTTTGGATCAACCAGTTTGG

## SP020 amino acid (SEQ ID NO:32)

NSEKKADNATTIKIATVNRSGSEKRWDKIQELVKKDGITLEFTEFTDYSQPNKATADGEVDLNAFQHY  
NFLNNWNKENGKDLVAIADTYISPIRLYSLNGSANKYTKVEDIPANGEI AVPN DATNESRALYLLQSA  
GLIKLDVSGTALATVANIKENPKNLKITELDASQTARSLSSVDAAVVNNTFVTEAKLDYKKS LFK EQAD  
ENSKQWYNIIVAKKDWETSPKADA IKKVIAAYHTDDVKKVIEESSDGLDQPVW

## SP021 nucleotide (SEQ ID NO:33)

TTCGAAAGGGTCAGAAGGTGCAGACCTTATCAGCATGAAAGGGGATGTCATTACAGAACATCAATTTTA  
TGAGCAAGTGAAGCAACCTTCAGCCCAACAGTCTTGTTAAATATGACCATCCAAAAAGTTTGTGA  
AAAACAATATGGCTCAGAGCTTGATGATAAAGAGGTTGATGATACTATTGCCGAAGAAAAACAATA  
TGGCGAAACTACCAACGTGTCTTGTCAAGCAGGTATGACTCTTGAAACACGTAAAGCTCAAATTG  
TACAAGTAAATTAGTTGAGTTGGCAGTTAAGAAGGTAGCAGAAGCTGAATTGACAGATGAAGCCTATAA  
GAAAGCCTTTGATGAGTACACTCCAGATGTAACGGCTCAAATCATCCGCTTAAATAATGAAGATAAGGC  
CAAAGAAGTTCTCGAAAAAGCCAAGGCAGAAGGTGCTGATTTTGTCAATTAGCCAAAGATAATTCAAC  
TGATGAAAAACAAAAGAAATGGTGGAGAAATTACCTTTGATTCTGCTCAACAGAAAGTACCTGGAGC  
AAGTCCAAAAAGCCGCTTTTCGCTTTTAGATGTGGGATGGTGTTCCTGGATGTGGATTACAGCAACTG  
GGGCACACCAAGCCTACAG

## SP021 amino acid (SEQ ID NO:34)

SKGSEGADLISMKGDVITEHQFYEQVKSNPQAQVLLNMTIQKFVEKQYSELDDKEVDDTIAEEKKQY  
GENYQRVLSQAGMTLETRKAQIRTSKLVELAVKKVAEAE L TDEAYKKAFDEYTPDVTAQIIIRLNNEDKA  
KEVLEKAKAEGADFAQLAKDNSTDEKTKENGGEITFDSASTEVPGASPKKPLFAFRGMVFLD V DYSNW  
GTPSLQ

## SP022 nucleotide (SEQ ID NO:35)

GGGGATGGCAGCTTTTAAAAATCCTAACAAATCAATACAAAGCTATTACAATTGCTCAAACCTCTAGGTGA  
TGATGCTTCTTCAGAGGAATTGGCTGGTAGATATGGTCTGCTGTTCAAGTGTACAGAAGTGACTGCCTC  
AAACCTTTCAACAGTTAAACTAAAGCTACGGTTGTAGAAAAACCACTGAAAGATTTTAGAGCGTCTAC  
GTCTGATCAGTCTGGTTGGGTGGAATCTAATGGTAAATGGTATTCTATGAGTCTGGTGTGTGAAGAC  
AGGTTGGGTGAAACAGATGGTAAATGGTACTATTTGAATGACTTAGGTGTGATGCAGACTGGATTTGT  
AAAATTTTCTGGTAGCTGGTATTACTTGAGCAATTCAGGTGCTATGTTTACAGGCTGGGGAACAGATGG  
TAGCAGATGGTTCTACTTTGACGGCTCAGGAGCTATGAAGACAGGCTGGTACAAGGAAATGGCACTTG  
GTATTACCTTGACGAAGCAGGTATCATGAAGACAGGTTGGTTTAAAGTCGGACCACTGGTACTATGC  
CTACGGTTCAGGAGCTTTGGCTGTGAGCACAACAACACCAGATGGTTACCGTGTAAATGGTAAATGGTGA  
ATGGGTAAAC

## SP022 amino acid (SEQ ID NO:36)

GMAAFKNPNNQYKAITIAQTLGDDASSEELAGRYGSAVQCTEVTASNLSVTKATVVEKPLKDFRST  
SDQSGWVESNGKWYFYESGDKVTGWKTDGKWYYLNDLGVMQTGFVKFSGSWYYLSNSGAMFTGWGTDG  
SRWFYFDGSGAMKTGWYKENGTYWYLD EAGIMKTGWFKVGPWHYYAYGSGALAVSTTTPDGYRVNGNGE  
WVN

## SP023 nucleotide (SEQ ID NO:37)

AGACGAGCAAAAAATTAAGCAAGCAGAAGCGGAAGTTGAGAGTAACAAGCTGAGGCTACAAGGTTAAA  
AAAAATCAAGACAGATCGTGAAGAAGCAGAAGAAGCTAAACGAAGAGCAGATGCTAAAGAGCAAGG  
TAAACCAAAGGGCGGGCAAAACGAGGAGTTCCTGGAGAGCTAGCAACACCTGATAAAAAAGAAAATGA  
TGCGAAGTCTTCAGATTCTAGCGTAGGTGAAGAACTCTTCCAAGCCCATCCCTGAAACCAGAAAAAAA  
GGTAGCAGAAGCTGAGAAGAAGGTTGAAGAAGCTAAGAAAAAGCCGAGGATCAAAAAGAAGAAGATCG  
CCGTAAC TACCCAACCAATACTTACAAAACGCTTGAACCTGAAATTGCTGAGTCCGATGTGGAAGTTAA  
AAAAGCGGAGCTTGAAC TAGTAAAGAGGAAGCTAAGGAACCTCGAAACGAGGAAAAAGTTAAGCAAGC  
AAAAGCGGAAGTTGAGAGTAAAAAGCTGAGGCTACAAGGTTAGAAAAATCAAGACAGATCGTAAAAA  
AGCAGAAGAAGAAGCTAAACGAAAAGCAGCAGAAGAAGTAAAGTTAAAGAAAAACCAAGCTGAAACAAC  
ACAACCAAGCGCGGCTCCAAAAGCAGAAAAACCAAGCTCCAGCTCCAAAACCAAGAGATCCAGCTGAACA  
ACCAAAAGCAGAAAAACCAAGCTGATCAACAAGCTGAAGAAGACTATGCTCGTAGATCAGAAGAAGAATA  
TAATCGCTTGACTCAACAGCAACCGCCAAAAAAGTAAAAACCAAGCACAACCATCTACTCCAAAAACAGG

Table 1

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CTGGAAACAAGAAAACGGTATGTGGTACTTCTACAATACTGATGGTTCAATGGCGACAGGATGGCTCCA  
AAACAATGGCTCATGGTACTACCTCAACAGCAATGGCGCTATGGCGACAGGATGGCTCCAAAACAATGG  
TTCATGGTACTATCTAAACGCTAATGGTTCAATGGCAACAGGATGGCTCCAAAACAATGGTTCATGGTA  
CTACCTAAACGCTAATGGTTCAATGGCGACAGGATGGCTCCAATACAATGGCTCATGGTACTACCTAAA  
CGCTAATGGTTCAATGGCGACAGGATGGCTCCAATACAATGGCTCATGGTACTACCTAAACGCTAATGG  
TGATATGGCGACAGGTTGGGTGAAAGATGGAGATACCTGGTACTATCTTGAAGCATCAGGTGCTATGAA  
AGCAAGCCAATGGTTCAAAGTATCAGATAAATGGTACTATGTCAATGGCTCAGGTGCCCTTGCGATCAA  
CACAACGTAGATGGCTATGGAGTCAATGCCAATGGTGAATGGGTAAC

**SP023 amino acid (SEQ ID NO:38)**

DEQIKQAEAEVESKQAEATRLKKIKTDREEAEAEAKRRADAKEQGGKPKGRAKRGVPGELATPDKKEND  
AKSSDSSVGEETLPSPSLKPEKKVAEAEKKVEEAKKKAEDQKEEDRRNYPTNTYKTLELEIAESDVEVK  
KAELELVKEEAKPEPRNEEKVKQAKAEVESKKAETRLKIKTDRKKAEEAEAKRAAEEDKVEKPAEQP  
QPAPAPKAEKPAPAPKPNPAEQPKAEKPADQQAEDYARRSEEEYNRLTQQPPKTEKPAQPSSTPKTG  
WKQENGMWYFYNTDGSMTGWLQNNGSWYYLNSNGAMATGWLQNNGSWYYLNNANGSMATGWLQNNGSWY  
YLNANGSMATGWLQYNGSWYYLNNANGSMATGWLQYNGSWYYLNNANGDMATGWVKDGTWYYLEASGAMK  
ASQWFKVSDKWYYVNGSGALAVNTTVDGYGVNANGEWVN

**SP025 nucleotide (SEQ ID NO:39)**

CTGTGGTGAGGAAGAACTAAAAAGACTCAAGCAGCACACAGCCAAAACAACAAACGACTGTACAACA  
AATTGCTGTTGGAAAAGATGCTCCAGACTTTCACATTGCAATCCATGGATGGCAAAGAAGTTAAGTTATC  
TGATTTTAAGGGTAAAAAGGTTTACTTGAAGTTTGGGCTTCATGGTGTGGTCCATGCAAGAAAAGTAT  
GCCAGAGTTGATGGAAGTACGGCGCAAACCAGATCGTGATTTGCAAAATCTTACTGTCAATTGCCACCAGG  
AATTCAAGGTGAAAAAAGTGTGAGCAATTTCCACAATGGTTCCAGGAACAGGATATAAGGATATCCC  
AGTTCTTTATGATACCAAAGCAACCCTTCCAAGCTTATCAAATTCGAAGCATTCTACAGAATATT

**SP025 amino acid (SEQ ID NO:40)**

CGEEETKKTQAAQPKQQTTVQQIAVGKDAPDFTLQSMGKEVKLSDFKGGKVYLKFWASWCGPCKKSM  
PELMELAAKPRDRDFEILTUPIAPIQGEKTVEQFPQWFQEQGYKDI PVLYDTKATTSKLIKFEAF LQNI

**SP028 nucleotide (SEQ ID NO:41)**

GACTTTTAACAATAAACTATTGAAGAGTTGCACAATCTCCTTGCTCTCTAAGGAAATTTCTGCAACAGA  
ATTGACCCCAAGCAACACTTGAAAATATCAAGTCTCGTGAGGAAGCCCTCAATTCAATTGTCAACCATCGC  
TGAGGAGCAAGCTCTTGTTCAGCTAAAGCCATTGATGAAGCTGGAATTGATGCTGACAATGTCTCTTC  
AGGAATTCACATTGCTGTTAAGGATAACATCTCTACAGACGGTATCTCACAACTGCTGCCCTCAAAAAAT  
GCTCTACAACATATGAGCCAATCTTGTATGCGACAGCTGTGCAATGCAAAAACCAAGGGCATGATTGT  
CGTTGGAAAGACCAACATGGACGAATTTGCTATGGGTGGTTCAGGAGAACTTCACACTACGGAGCAAC  
TAAAAACGCTTTGGAACCAAGCAAGGTTCTTGGTGGGTCACTCAAGTGGTTCTGCCCGCAGCTGTAGCCTC  
AGGACAAGTTCTGCTTGTCACTTGGTCTGATACCTGGTGGTTCATCCGCCAACCTGCTGCCCTTCAACGG  
AATCGTTGGTCTCAAACCAACCTACGGAACAGTTTCACGTTTCGGTCTCATTGCCTTTGGTAGCTCATT  
AGACCAGATTGGACCTTTGCTCTTACTGTTAAGGAAATGCCCTCTTGCTCAACGCTATTGCCAGCGA  
AGATGCTAAAGACTCTACTTCTGCTCTCTGCTCCGATCGCCGACTTTACTTCAAAAATCGGCCAAGACAT  
CAAGGGTATGAAAATCGCTTTGCCTAAGGAATACCTAGGCGAAGGAATTGATCCAGAGGTTAAGGAAAC  
AATCTTAAACCGCGGCCAAACACTTTGAAAAATTTGGGTGCTATCGTCAAGAAAGTCAGCCTTCTCTACTC  
TAAATACGGTGTGTCGCTTTATTACATCATCGCTTCATCAGAAGCTTCATCAAACCTGCAACGCTTCGA  
CGGTATCCGTTACGGCTATCGCGCAGAAGATGCAACCAACCTTGATGAAATCTATGTAAACAGCCGAAG  
CCAAGGTTTTGGTGAAGAGGTAAAACGTCGTATCATGCTGGGTACTTTCAGTCTTTCATCAGGTTACTA  
TGATGCCTACTACAAAAGGCTGGTCAAGTCCGTACCTCATCATTCAAGATTTGAAAAAGTCTTCGC  
GGATTACGATTTGATTTTGGGTCCAACCTGCTCCAAGTGTGCTTATGACTTGGATTCTCTCAACCATGA  
CCCAGTTGCCATGTACTTAGCCGACCTATTGACCATACCTGTAAACTTGGCAGGACTGCCTGGAATTTT  
GATTCTGCTGGATTCTCTCAAGGTCTACCTGTCCGACTCCAATTGATTGGTCCCAAGTACTCTGAGGA  
AACCATTTACCAAGCTGCTGCTGCTTTTGAAGCAACAACAGACTACCACAAACAACAACCCGTGATTTT  
TGGAGGTGACAAC

**SP028 amino acid (SEQ ID NO:42)**

TFNNTIEELHNLVLSKEISATELTQATLENIKSREEALNSFVTIAEEQALVQAKAIDEAGIDADNVLS  
GIPLAVKDNISTDGILTAAASKMLNYEPIFDATAVANAKTKGMIVVGKTNMDEFAMGSGSETSHYGAT  
KNAWNHSKVPGGSSSGSAAAVASGVRLSLGSDTGGSIRQPAAFNGIVGLKPTYGTVSRFGLIAFGSSL

Table 1

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DQIGPFAPTIVENALLLNIAISEDADKSTSAFVRIADFTSKIGQDIKGMKIALPKEYLGEIDPEVKET  
ILNAAKHFEKLGAIVEEVSLPHSKYGVAVVYIIASSEASSNLQRFDGIRYGYRAEDATNLDEIYVNSRS  
QGFGEVKKRIMLTGTFSLSSGYDAYYKAGQVRTLIIQDFEKVFADYDLILGPTAPSVAYDLDSLNDH  
PVAMYLADLLTIPVNLAGLPGISIPAGFSQGLPVGLQLIGPKYSEETIYQAAAAFEATTDYHKQPVIF  
GGDN

**SP030 nucleotide (SEQ ID NO:43)**

CTTTACAGGTAAACAACATCAAGTCGGCGACAAGGCGCTTGATTTTTCTCTTACTACAACAGATCTTTC  
TAAAAAATCTCTGGCTGATTTTGATGGCAAGAAAAAGTCTTGAGTGTCGTTCTTCTATCGATACAGG  
CATCTGCTCAACTCAAACACGTCGTTTAAATGAAGAATTGGCTGGACTGGACAACACGTCGTATTGAC  
TGTTTCAATGGACCTACCTTTTGCTCAAAAACGTTGGTGCGGTGCTGAAGGCCTTGACAATGCCATTAT  
GCTTTCAGACTACTTTGACCATTCCTTCGGGCGCGATTATGCCCTCTTGATCAACGAATGGCACCTATT  
AGCACGCGCAGTCTTTGTCTCGATACTGACAATACGATTGCGTACGTTGAATACGTGGATAATATCAA  
TTCTGAGCCAAACTTCGAA

**SP030 amino acid (SEQ ID NO:44)**

FTGKQLQVGDKALDFSLTTTDLSSKSLADFDGKKKVLVSVPSIDTGICSTQTRRFNEELAGLDNTVVLT  
VSMDLPAQKRWCAGELDNAIMLSDFDHSFGRDYALLINEWHLLARAVFVLDTNTIRYVEYVDNIN  
SEPNFE

**SP031 nucleotide (SEQ ID NO:45)**

CCAGGCTGATACAAGTATCGCAGACATTCAAAAAGAGGCGAACTGGTTGTCGGTGTCAAACAAGACGT  
TCCCAATTTTGGTTACAAGATCCCAAGACCGGTACTTATTCTGGTATCGAAACCGACTTGGCCAAAGAT  
GGTAGCTGATGAATCAAGGTCAAGATTCGCTATGTGCCGGTTACAGCACAAACCCGCGGCCCCCTTCT  
AGACAATGAACAGGTGATATGGATATCGCGACCTTTACCATCACGGACGAACGCAAAAACTCTACAA  
CTTTACCACTCCCTACTACACAGACGCTTCTGGATTTTGGTCAATAAATCTGCCAAAAATCAAAAAGAT  
TGAGGACCTAAACGCAAAACCATCGGAGTCGCGCAAGGTTCTATACCCCAACGCTGATTACTGAACT  
GGGTAAAAAGAAAGGTCTGAAGTTTAAATTCGTCGAACCTGGTTCTTACCCAGAATTGATTACTTCCCT  
GCACGCTCATCGTATCGATACCTTTTCCGTTGACCGCTCTATTCTATCTGGCTACACTAGTAAACGGAC  
AGCACTACTAGATGATAGTTTCAAGCCATCTGACTACGGTATTTGTTACCAAGAAATCAAAATACAGAGCT  
CAACGACTATCTTGATAAATTGGTTACTAAATGGAGCAAGGATGGTAGTTTGCAGAACTTTATGACCG  
TTACAAGCTCAAACCATCTAGCCATACTGCAGAT

**SP031 amino acid (SEQ ID NO:46)**

QADTSIADIQKRGELVVGKQDVPNFGYXDPKGTGYSIGIETDLAKMVADELKVKIRYVPVTAQTRGPLL  
DNEQVDMDIATFTITDERKKLYNFTSPYYTDASGLVFNKSAKKKIEDLNGKTIGVAQGSITORLITEL  
GKKKGLKFKFVELGSPELITSLHAHRIDTFVDRSILSGYTSKRALLDSDFKPSDYGIIVTKKSNTEL  
NDYLDNLVTKWSKDGSLQKLYDRYKLPSSHTAD

**SP032 nucleotide (SEQ ID NO:47)**

GTCTGTATCATTTGAAAAACAAAGAAACAAACCGTGGTGTCTTgACTTTCACTATCTCTCAAGACCAAAT  
CAAACCAGAAATTGGACCGTGTCTTCAAGTCAGTGAAGAAATCTCTTAATGTTCCAGGTTTCCGTAAAGG  
TCACCTTCCACGCCCTATCTTCGACCAAAAATTTGGTGAAGAAGCTCTTTATCAAGATGCAATGAACGC  
ACTTTTGCCAAACGCTTATGAAGCAGCTGTAAAGAAGCTGGTCTTGAAGTGGTTGCCCAACCAAAAAT  
TGACGTAACCTCAATGGAAAAAGGTCAAGACTGGGTTATCACTGCTGAAGTCGTTACAAAACCTGAAGT  
AAAATTGGGTGACTACAAAACCTTGAAGTATCAGTTGATGTAGAAAAAGAAGTAACGACGCTGATGT  
CGAAGAGCGTATCGAACGCGAACGCAACAACCTGGCTGAATTGGTTATCAAGGAAGCTGCTGCTGAAAA  
CGGCGACACTGTTGTGATCGACTTCGTTGGTTCTATCGACGGTGTGAAATTTGACGGTGGAAGGTTGA  
AACTTCTCACTTGGACTTGGTTCAAGTCAATTCACCTGGTTTCAAGACCAATTTGGTAGGTCACCTC  
AGCTGGCGAAACCGTTGATGTTATCGTAACATTCACGAGAACTACCAAGCAGAAGACCTTGCAGGTAA  
AGAAGCTAAATTCGTGACAACTATCCACGAAGTAAAGCTAAAGAAGTTCGGCTCTTGACGATGAAGT  
TGCAAAAGACATTGATGAAGAAGTTGAAACACTTGCTGACTTGAAAGAAAAATACAGCAAGAATTGGC  
TGCTGCTAAAGAAGAAGCTTACAAAGATGCAAGTTGAAGGTGCAGCAATTGATACAGCTGTAGAAAATGC  
TGAAATCGTAGAACTTCCAGAAGAAATGATCCATGAAGAAGTTACCGTTTCAGTAAATGAATTCCTTG  
GAATTTGCAACGTCAAGGGATCAACCTTGACATGTACTTCCAAATCACTGGAAGTCAAGAAAGACCT  
TCACAACCAATACCAAGCAGAAGCTGAGTCACGTACTAAGACTAACCTTGTATCGAAGCAGTTGCCAA  
AGCTGAAGGATTTGATGCTTCAGAAGAAGAAATCCAAAAAGAAGTTGAGCAATTGGCAGCAGACTACAA

Table 1

CATGGAAGTTGCACAAGTTCAAAACTTGCTTTTCAGCTGACATGTTGAAACATGATATCACTATCAAAAA  
AGCTGTTGAATTGATCACAAAGCACAGCAACAGTAAAA

**SP032 amino acid (SEQ ID NO:48)**

SVSFENKETNRGVLFTTISQDQIKPELDRVFKSVKKS LNPVGF RKGHLPRPIFDQKFGEEALYQDAMNA  
LLPNAYEAAVKEAGLEVVAQPKIDVTSMEKQGDWVITAEVVTKEVVKLG DYKNLEVSVDVEKEVT DADV  
EERIERERNLAE LVIKEAAAENGDTVVIDFVGSIDGVEFDGGKGENFSLGLSGSQFIPGFEDQLVGHS  
AGETVDVIVTFPEDYQAEDLAGKEAKFVTTIHEVKAKEVPALDDELAKDIDEEVETLADLKEKYSKELA  
AAKEEAYKDAVEGA AIDTAVENAEIVELPEEMIHEEVHRSVNEFLGNLQRQGINPDMYFQITGTTQEDL  
HNQYQAEAESRTKTNLVIEAVAKAEGFDASEEEIQKEVEQLAADYNMEVAQVQNLLSADMLKHDITIKK  
AVELITSTATVK

**SP033 nucleotide (SEQ ID NO:49)**

TGGTCAAAAAGGAAAGTCAGACAGGAAAGGGATGAAAATTGTGACCAGT TTTTATCCTATCTACGCTAT  
GGTTAAGGAAGTATCTGGTGACTTGAATGATGTTCCGATGATTCAGTCAAGTAGTGGTATTCACTCCTT  
TGAACCTTCGGCAAATGATATCGCAGCCATCTATGATGCAGATGTCTTTGTTTACCATTCTCATACACT  
CGAATCTTGGGCAGGAAGTCTGGATCCAAATCTAAAAAATCCAAAGTGAAGGTCTTAGAGGCTTCTGA  
GGGAATGACCTTGGAACGTGTCCCTGGACTAGAGGATGTGGAAGCAGGGGATGGAGTTGATGAAAAAAC  
GCTCTATGACCTTCACACATGGCTAGATCCTGAAAAAGCTGGAGAAGAAGCCCAAATTATCGCTGATAA  
ACTTTCAGAGGTGGATAGTGAGCATAAAGAGACTTATCAAAAAATGCGCAACCTTTATCAAAAAAGCT  
CAGGAAT

**SP033 amino acid (SEQ ID NO:50)**

GQKESQTKGKMKIVTSFYPIYAMVKEVSGDLNDV RMIQSSSGIHSFEPSSANDIAAIYDADVFVYHSHTL  
ESWAGSLDPNLKSKYKVL EASEGMTLERVPGL EDVEAGDGVDEKTL YDPHTWLDPEKAGEEAQIIADK  
LSEVDSEHKETYQKNAQPLSKKLRN

**SP034 nucleotide (SEQ ID NO:51)**

GAAGGATAGATATATTTTAGCATTTGAGACATCCTGTGATGAGACCAGTGTGCGCGTCTTGAAAAACGA  
CGATGAGCTCTTGTCCAATGTCATTGCTAGTCAAATGAGAGTCACAAACGTTTGGTGGCGTAGTGCC  
CGAAGTAGCCAGTCGTCACCATGTCGAGGTCAATACAGCCTGTATCGAGGAGGCATTGGCAGAAGCAGG  
GATTACCGAAGAGGACGTGACAGCTGTGCGGTTACCTACGGACCAGGCTTGGTCGGAGCCTTGTAGT  
TGGTTTGTACAGCTGCCAAGGCCTTTGCTTGGGCTCACGGACTTCCACTGATTCTCTGTTAATCACATGGC  
TGGGCACCTCATGGCAGCTCAGAGTGTGGAGCCTTTGGAGTTTCCCTTGCTAGCCCTCTTGGTCAGCGG  
CGGACACACAGAGTTGGTTTATGTTTTCGGAGGCAGGAGATTATAAGATTGTTGGGGAAACCCGTGATGA  
TGCGGTTGGTGAGGCTTATGATAAGGTCGGCCGTGTCATGGGCTTGACCTATCCTGCAGGTCGTGAGAT  
TGACGAGCTGGCTCATCAGGGCAGGATATTTATGATTTCCTCCCGTGCCATGATTAAGGAAGATAATCT  
GGAGTTCTCCTTCTCAGGTTTGAATCTGCCTTTATCAATCTTCATCACAATGCCGAGCAAAAAGGGAGA  
AAGCCTGTCTACAGAAGATTGTGTGCTTCTTCCAAGCAGCAGTTATGGACATTCTCATGGCAAAAAC  
CAAGAAGGCTTTGGAGAAATATCCTGTAAAATCCTAGTTGTGGCAGGTGGTGTGGCAGCCAATAAAGG  
TCTCAGAGAACGCCTAGCAGCCGAAATCACAGATGTCAAGGTTATCATCCCCCTCTGCGACTCTGCGG  
AGACAATGCAGGTATGATTGCCATGCCAGCGTCAGCNAGTGAACAAAGAAAACCTTCGCAGGCTGGGA  
CCTCAATGCCAAACCAAGTCTTGCTTTGATACCATGGAA

**SP034 amino acid (SEQ ID NO:52)**

KDRYILAFETSCDETSVAVLKNDELLSNVIASQIESHKRFGGVVPEVASRHHVEVITACIEEALAEAG  
ITEEDVTAVAVTYGPGLVGALLVGLSAAKAFWAHGLPLIPVNHMAGHLMAAQSVEPLEFPL LALLVSG  
GHTEL VVYSEAGDYKIVGETRDDAVGEAYDKVGRVMGLTYPAGREIDELAHQGD IYDFPRAMIKEDNL  
EFSFSGLKSAFINLHHNAEQKESLSTEDLCASFQAAVMDILMAKTKKALEKYPVKILVVAGGVAANKG  
LRERLAAEITDVKVIIPLRLCGDNAGMIAYASVSXWNKENFAGWDLNAKPSLAFDTME

**SP035 nucleotide (SEQ ID NO:53)**

GGTAGTTAAAGTTGGTATTAACGGTTTCGGACGTATCGGTCGTCTTGCTTTCCGTCGTATCCAAAACGT  
AGAAGGTGTTGAAGTTACACGCATCAACGACCTTACAGATCCAGTTATGCTTGACACTTGTGAAATA  
CGACACAATCAAGGTCGTTTCGACGGTACTGTTGAAGTTAAAGAAGGTGGATTGAACTTAACGGTAA  
ATTATCAAAAGTTTCTGCTGAACGTGATCCAGAACAAATCGACTGGGCTACTGACGGGTAGAAATCGT  
TCTTGAAGCTACTGGTTTCTTTGCTAAGAAAGAAGCAGCTGAAAAACACCTTAAAGGTGGAGCTAAAAA

Table 1

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AGTTGTTATCACTGCTCCTGGTGGAAACGACGTTAAACAGTTGTATTCAACACTAACCACGACGTTCT  
TGACGGTACTGAAACAGTTATCTCAGGTGCTTCATGTACTACAACTGCTTGGCTCCAATGGCTAAAGC  
TCTTCAAGACAACCTTGGTGTGTTGAAGGATTGATGACTACTATCCACGCTTACACTGGTGACCAAT  
GATCCTTGACGGACCACACCGTGGTGGTGACCTTCGCCGTGCTCGCGCTGGTGTGCAACATCGTTCC  
TAACTCAACTGGTGTGCAAAAGCTATCGGTCTTGTAAATCCAGAAATTGAATGGTAAACTTGACGGATC  
TGCAACACGGCTTCCAACCCAACGGATCAGTTACTGAATTGGTAGCAGTTCTTGAAAAGAACGTTAC  
TGTTGATGAAGTGAACGCAGCTATGAAAGCAGCTTCAAACGAATCATACGGTTACACAGAAGATCCAAT  
CGTATCTTCAGATATCGTAGGTATGTCTTACGGTTTATTGTTGACGCAACTCAAATAAGTTCTTGA  
CGTTGACGGTAAACAATTGGTTAAAGTTGTATCATGGTACGACAACGAAATGTCATACACTGCACAAC  
TGTTCTGACTCTTGAATACTTCGCAAAAATTGC

**SP035 amino acid (SEQ ID NO:54)**

VVKVINGFGRIGRLAFRRIQNVEGVEVTRINDLTPVMLAHLKLYDTTQGRFDGTVEVKEGGFEVNGK  
FIKVS AERDPEQIDWATDGV EIVLEATGFFAKKEAAEKHLKGGAKKVITAPGGNDVKTVFNTNHDVL  
DGTETVISGASCTTNCLAPMAKALQDNFVVEGLMTTTHAYTGDMILDGPHRGGDLRRARAGAAANIVP  
NSTGAAKAIGLVIPELNGKLDGSAQRVPTPTGSVTELAVLEKNVTVDEVNAAMKAASNESYGYTEDPI  
VSSDIVGMSYGSFLDATQTKVLDVDGKQLVKVVSWDNEMSYTAQLVRTLGLIRKNC

**SP036 nucleotide (SEQ ID NO:55)**

TTCTTACGAGTTGGGACTGTATCAAGCTAGAACGGTTAAGGAAAATAATCGTGTTCCTATATAGATGG  
AAAACAAGCGACGCAAAAAACGGAGAATTTGACTCCTGATGAGGTTAGCAAGCGTGAAGGAATCAATGC  
TGAGCAAATCGTCATCAAGATAACAGACCAAGGCTATGTCATTCACATGGCGACCACTATCATTATTA  
CAATGGTAAAGGTTCCCTTATGACGCTATCATCAGTGAAGAATTACTCATGAAAGATCCAACTATAAGCT  
AAAAGATGAGGATATTGTTAATGAGGTCAAGGGTGGATATGTTATCAAGGTAGATGGAAAATACTATGT  
TTACCTTAAGGATGCTGCCACGCGGATAACGTCCTGACAAAAGAGGAAATCAATCGACAAAAACAGA  
GCAATAGTCAACATCGTGAAGGTGGAACCTCAAGAAACGATGGTGCTGTTGCCTTGGCACGTTCCGAAGG  
ACGCTATACTACAGATGATGGTTATATCTTTAATGCTTCTGATATCATAGAGGATACTGGTGATGCTTA  
TATCGTTCCTCATGGAGATCATTACCATTACATTCCTAAGAAATGAGTTATCAGCTAGCGAGTTGGCTGC  
TGCAGAAGCCTTCCTATCTGGTCGAGGAAATCTGTCAAATTCAGAACCCTATCGCCGACAAAATAGCGA  
TAACACTTCAAGAACAACTGGGTACCTTCTGTAAGCAATCCAGGAACATAAACTAACAACAAGCA  
CAACAGCAACACTAACAGTCAAGCAAGTCAAAGTAATGACATTGATAGTCTCTTGAAACAGCTCTACAA  
ACTGCCTTTGAGTCAACGACATGTAGAATCTGATGGCCTTGTCTTGTATCCAGCACAAATCACAAGTCG  
AACAGCTAGAGGTGTTGCAGTGCCACAGGAGATCATTACCACTTCATCCCTTACTCTCAAATGTCTGA  
ATTGGAAGAACGAATCGCTCGTATTATTCCTTCCTGTTATCGTTCAAACCATTGGGTACCGAGATTCAG  
GCCAGAACAACCAAGTCCACAACCGACTCCGGAACCTAGTCCAGGCCCGCAACCTGCACCAAACTTAA  
AATAGACTCAAATCTTCTTGGTTAGTCAAGTGGTACGAAAGTTGGGGAAGGATATGTTATTCGAAGA  
AAAGGGCATCTCTCGTTATGTCTTTGCGAAAGATTTACCATCTGAAACTGTTAAAAATCTTGAAAGCAA  
GTTATCAAAAACAAGAGAGTGTTCACACACTTAACTGCTAAAAAGAAAAATGTTGCTCCTCGTGACCA  
AGAATTTTATGATAAAGCATATAATCTGTTAACTGAGGCTCATAAAGCCTTGTTTGNAAAATAAGGGTCG  
TAATTCGTATTCGAAGCCTTAGACAAATTATTAGAACGCTTGAATGATGAATCGACTAATAAAGAAAA  
ATTGGTAGATGATTTATTGGCATTCTTAGCACCAATTACCCATCCAGAGCGACTTGGCAAAACCAATTC  
TCAAATTGAGTATACTGAAGACGAAGTTCGTATTGCTCAATTAGCTGATAAGTATACAACGTCAGATGG  
TTACATTTTTGATGAACATGATATAATCAGTGATGAAGGAGATGCATATGTAACGCCTCATATGGGCCA  
TAGTCACTGGATTGGAAAAGATAGCCTTCTGATAAGGAAAAAGTTGCAGCTCAAGCCTATACTAAAGA  
AAAAGGTATCCTACCTCCATCTCCAGACGCAGATGTTAAAGCAAATCCAACTGGAGATAGTGCAGCAGC  
TATTTACAATCGTGTGAAAGGGGAAAAACGAATTCACCTCGTTCCGACTTCCATATATGGTTGAGCATA  
AGTTGAGGTTAAAAACGGTAATTTGATTATTCCTCATAGGATCATTACCATAATATTAATTTGCTTG  
GTTTGATGATCACACATACAAAGCTCCAAATGGCTATACCTTGGAAAGATTGTTTTCGACGATTAAGTA  
CTACGTAGAACACCCTGACGAACGTCACATTCATGATGGATGGGGCAATGCCAGTGAGCATGTGTT  
AGGCAAGAAAGACCACAGTGAAGATCCAAATAAGAACTTCAAAGCGGATGAAGAGCCAGTAGAGGAAAC  
ACCTGCTGAGCCAGAAGTCCCTCAAGTAGAGACTGAAAAAGTAGAAGCCCAACTCAAAGAAGCAGAAGT  
TTTGCTTGCGAAAGTAACGGATTCTAGTCTGAAAGCCAAATGCAACAGAACTCTAGCTGGTTTACGAAA  
TAATTTGACTCTTCAAATTATGGATAACAATAGTATCATGGCAGAGCAGAAAAATTACTTGCGTTGTT  
AAAAGGAAGTAATCCTTCATCTGTAAGTAAGGAAAAATAAAC

**SP036 amino acid (SEQ ID NO:56)**

SYELGLYQARTVKENNRVSYIDGKQATQKTENLTPDEVSKREGINAEQIVIKITDQGYVTSBGDHYHY  
NGKVPYDAIISEELMKDPNYKLKDEIVNEVKGYYVIKVDGKYVYVKDAAHADNVRTKEEINRQKE

Table 1

HSQHREGGTPRNDGAVALARSQGRYTTDDGYIFNASDIIEDTGDAYIVPHGDHYHYI PKNELSASELAA  
AEAFLSGRGNLSNSRTYRRQNSDNTSRTNWVPSVSNPGTTNTNTSNNSTNSQASQSNDDISLLKQLYK  
LPLSQRHVESDGLVFDPAQITSRTARGVAVPHGDHYHFIPYSQMSLEERIARIIPLYRSNHWVPDSR  
PEQSPQPTPEPSPGQPAPNLKIDSNSSLVSQLVRKVGEGYVFEKGISRYVFAKDLPSQTVKNLESK  
LSKQESVSHLTAKKENVAPRDQEFYDKAYNLLTEAHKALFXNKGKNSDFQALDKLLERLNDESTNKEK  
LVDDLLAFLAPITHPERLGKPNISQIEYTEDEVRIAQLADKYTTSDGYIFDEHDIISDEGDAYVTPHMGH  
SHWIGKDSLSDEKVAQAAYTKEKGILPPSPDADVKNPTGDSAAAIYNRVKGEKRIPLVRLPYMVEHT  
VEVKGNLII PHKDYHNKIFAWFDDHTYKAPNGYTTLEDLFATIKYYVEHPDERPHSNDGWNASEHVL  
GKKDHSSEDPNKNFKADEEPVEETPAEPEVPQVETEKVEAQLKEAEVLLAKVTDSSSLKANATETLAGLRN  
NLTLQIMDNNSIMAEAEKLLALLKGSNPSSVSKEKIN

**SP038 nucleotide (SEQ ID NO:57)**

TACTGAGATGCATCATAATCTAGGAGCTGAAAAGCGTTGAGCAGTGGCTACTACTATCGATAGTTTAA  
GGAGCGAAGTCAAAAAGTCAGAGCACTATCTGATCCAAATGTGCGTTTTGTTCCTTCTTGGCTCTAG  
TGAATGGCTTCGTTTTGACGGTGCTCATTCTGCGGTATTAGCTGAGAAATACAATCGTTCTACCTCC  
TTATCTTTTAGGACAGGGGGAGCTGCATCGCTTAACCAATATTTTGAATGCAACAGATGTTACCACA  
GCTGGAGAATAAACAAGTTGTGTATGTTATCTCACCTCAGTGGTTCAGTAAAAATGGCTATGATCCAGC  
AGCCTTCCAGCAGTATTTTAATGGAGACCAGTTGACTAGTTTTCTGAAACATCAATCTGGGGATCAGGC  
TAGTCAATATGCAGCGACTCGCTTACTGCAACAGTTCCCAAACGTAGCTATGAAGGACCTGGTTGAGAA  
GTTGGCAAGTAAAGAAGAATTGTCGACAGCAGACAATGAAATGATTGAATTATTGGCTCGTTTTAATGA  
ACGCCAAGCTTCCTTTTTTGGTCAGTTTTTCGGTTAGAGGCTATGTTAACTACGATAAGCATGTAGCTAA  
GTATTTAAAAATCTTGCCAGACCAGTTTTCTTATCAGGCAATAGAAGATGTTGTCAAAGCAGATGCTGA  
AAAAAATACTTCCAATAATGAGATGGGAATGGAAAATTATTTCTATAATGAGCAGATCAAGAAGGATTT  
GAAGAAATTAAGGATTTCTCAGAAAAGCTTTTACCTATCTCAAGTCGCCAGAGTATAATGNNTTGCAGTT  
GGTTTTAACACAGTTTTCTAAATCTAAGGTAACCCGATTTTTATCATTCCACCTGTTAATAAAAAATG  
GATGNACTATGCTGGTCTACGAGAGGATATGTACCAACAACCGTGCGAGAAGATTGCTACCAAGTTAGA  
AAGTCAAGGTTTTTACCAATATAGCAGATTTTTCTAAGGACGGCGGGAGCCTTTCTTTATGAAGGACAC  
CATTCACCTTGGTTGGTTGGTTGGTTGGCTTTTGACAAGGCAGTTGATCCTTCTCTATCCAATCCAC  
ACCAGCTCCGACTTACCATCTGAATGAGCGCTTTTTTACGAAAGATTGGGCGACTTATGATGGAGATGT  
CAAAGAA

**SP038 amino acid (SEQ ID NO:58)**

TEMHHNLGAEKRSVATTIDSFKERSQKVRALSDPNVRFVPPFGSSEWLRFDGAHSAVLAEKYNRSYRP  
YLLGQGAASLNQYFGMQMLPQLENKQVVYVISPOWFSKNGYDPAAFQQYFNGDQLTSFLKHQSGDQA  
SQYAAATRLQOFPNVAMKDLVQKLASKEELSTADNEMIELLARFNERQASFFGQFVSRGVYVNDKHWAK  
YLKILPDQFSYQAIEDVVKADAEKNTSNMGMENYFYNEQIKKDLKKLSDSKSFTYLSPEYNXLQL  
VLTQFSKSKVNPFIIPVNNKWMXYAGLRDMYQQTQVQKIRYQLESQGFNIADFSKDGGEFFFMKDT  
IHLGWLGLWLAFDKAVDPFLSNPTPAPTYHLNERFFSKDWATYDGDVKE

**SP039 nucleotide (SEQ ID NO:59)**

GGTTTTGAGAAAGTATTGACAGGGGGCCCTGATTGAGTCGATTGAGCAAGTGGAAGTACCGTATTGT  
GGAAATTACAGTTTCCAATAAAAACGAGATTGGAGACCATATCCAGGCTACCTTGATTATCGAAATTAT  
GGGGAACACAGTAATATCTACTGGTCGATAAAAAGCAGTCATAAAATCCTCGAAGTTATCAAAACAGT  
CGGCTTTTTACAAAAATAGCTACCGCACCTTACTTCCAGGATCGACCTATATCGCTCCGCCAAGTACAAA  
ATCTCTCAATCCTTTTACTATCAAGGATGAAAAGCTCTTTGAAATCCTGCAAACCAAGAACTAACAGC  
AAAAATCTTCAAAGCCTCTTTCAAGGTCCTGGGACGCGATACGGCAAATGAATTGGAAGGATACTGGT  
TAGTGAAGAACTTTCCGCTTTCCGAAATTTTTCAATCAAGAAACCAAGCCATGCTTGACTGAGACTTC  
CTTCAGTCCAGTTCTTTTGCAATCAGGTGGGAGAGCCTTTTGCAAATCTTTCTGATTGTTGGACAC  
CTACTATAAGGATAAGGCTGAGCGCGACCGCTCAAACAGCAGGCCAGTGAATGATTGCGTCGTGTTGA  
AAATGAATCTTCAAAAAACCGACACAAACTCAAAAAACAGGAAAAAGAGTTACTGGCGACAGACAACGC  
TGAAGAATTTCTGCAAAAAAGGAGAATTGCTGACAACCTTCTCCACCAAGTGCCTAACGACCAAGACCA  
GGTTATCTCTAGACAACTACTATACCAACCAACCTATCATGATTGCGCTTGATAAGGCTCTGACTCCCAA  
CCAGAAATGCCAACGCTATTTTAAACGGTATCAGAAACTCAAAGAAGCTGTCAAATCTTGACTGATTT  
GATTGAAGAAACCAAGCCACTATTCTCTATCTGGAAAGTGTAAGAACCGTCTCAACCAAGCTGGACT  
GGAAGAAATCGCTGAAATCCGTGAAGAATTGATTCAAACAGGTTTTATCCCGAGAAGACAACGGGAGAA  
AATCCAGAAACGCAAAAAACTAGAACAAATATCTAGCAAGCGATGGCAAAACCATCATCTATGTCGGACG  
AAACAATCTTCAAATAGGAAATTGACCTTTAAAAATGGCCCGCAAGGAGGAACCTTTGGTTCCATGCTAA  
GGACATTCCTGGAAGCCATGTTGTCATCTCAGGAAATCTTGACCATCTGATGCAGTCAAGACAGACGC

Table 1

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AGCAGAGTTAGCTGCCTACTTCTCTCAAGGGCGCCTGTCGAATCTGGTGCAGGTAGATATGATTGAAGT  
CAAAAACTCAATAAACCAACTGGTGAAAAACCCGGCTTTGTCACTTACACAGGACAAAAGACCCCTCCG  
CGTCACACCAGACTCCAAAAAATTGCATCCATGAAAAAATCC

**SP039 amino acid (SEQ ID NO:60)**

VLRKYLQGALIESIEQVENDRIVEITVSNKNEIGDHIQATLIIIEIMGKHSNILLVDKSSHKILEVIKHV  
GFSQNSYRLLPGSTYIAPPSTKSLNPFTIKDEKLFEILQTQELTAKNLQSLFQGLGRDTANELERILV  
SEKLSAFRNFFNQETKPCLTETSFSPVPFANQVGEPFANLSDLLDTYYKDKAERDRVKKQASELIRRVN  
NELQKNRHKLKKQEKELLATDNAEEFRQKGELLTTFLHQVPNDQDQVILDNYTTNQPIIMIALDKALTPN  
QNAQRYFKRYQKLKEAVKYLTDLIEETKATILYLESVETVLNQAGLEEIAEIREELIQTGFIRRRQREK  
IQKRKKLEQYLASDGKTIYVGRNNLQNEELTFKMARKEELWFHAKDIPGSHVVISGNLDPSDAVKTD  
AELAAYSQGRLSNLVQVDMIEVKKLNKPTGGKPGFVTTYTGQKTLRVTPDSKKIASMKKS

**SP040 nucleotide (SEQ ID NO:61)**

GACAACATTTACTATCCATACAGTAGAGTCAGCACCAGCAGAAAGTGAAGAAATCTTGAACAGTAGA  
AAAAGACAACAATGGCTATATTCCCAACCTAATCGGTCTCTTGGCCAATGCCCGACTGTTTGTAGAAGC  
CTACCAAATTGTCTCATCTATCCACCGTCGCAACAGCCTGACACCCGTTGAGCGTGAAGTGGTGCAAT  
CACGGCAGCCGTGACCAATGGTTGTGCCCTTCTGTGTCGAGGTACACAGCCCTTTCCATCAACAAAT  
CCAGATGAATGATGACTTGATTCAGCTCTTTCGAATCGTACTCCAATTGAAACAGATCCTAAATTGGA  
TACCCTAGCTAAGTTTACCTTGGCAGTTATCAATACCAAGGGTCGTGTAGGAGATGAAGCCTTGTCTGA  
GTTTTTAGAAGCTGGCTACACTCAACAAAATGCCTTGGATGTGGTTTTTGGTGTGACGCTTACCAATCCT  
CTGTAACATATGCCAACAACTTAGCTAATACCAATTAATCCAGAATTGCAACCTTATGCC

**SP040 amino acid (SEQ ID NO:62)**

TTFTHTVESAPAEVKEILETVEKDNNGYIPNLIGLLANAPTVEAYQIVSSIHRNSLTPVEREVQI  
TAAVTNGCAFCVAGHTAFSIKQIQMNDLIQALRNRTPIETDPKLDTLAKFTLAVINTKGRVGDEALSE  
FLEAGYTQQNALDVVFGVSLAILCNYYANLANPTINPELQPYA

**SP041 nucleotide (SEQ ID NO:63)**

GGCTAAGGAAAGAGTGGATGTACTAGCTTATAAACAGGGGTTGTTGAAACGAGAGAGCAGGCCAAGCG  
AGGTGTGATGGCTGGCCTAGTCGTAGCAGTCCTTAATGGAGAACGGTTTGACAAGCCAGGAGAGAAAAAT  
TCCAGATGACACCGAATTAACCTCAAGGGGGAGAACTCAAGTATGTGACCGCTGGTGGTTTGAAACT  
GGAAAAAGCCCTTGCAGGTCTTTGATTTGTGCGGTGGATGGCGGACTACGATTGATATCGGGGCTCTAC  
TGGAGGTTTTACCGATGTGATGTACAGAAATAGTGCCAAGTTGGTCTTTGCAGTCGATGTTGGTACCAA  
TCAGTTGGCTTGGAAATTACGCCAAGACCCACGAGTTGTGAGCATGGAGCAGTTCAATTTCCGCTATGC  
TGAAAAGACTGATTTGAGCAGGAGCCGAGCTTTGCCAGTATTGATGTGAGTTTCATTTCCCTTAGTCT  
GATTTTGGCAGCCTTGCACCGTGTCTTGGCTGATCAAGGTCAGGTGGTAGCACTTGTCAAACCTCAGTT  
TGAGGCAGGACGTGAGCAGATTGGGAAAAATGGAATTATTCGAGATGCTAAGGTTTCATCAGAATGTCTT  
TGAATCTGTAACAGCTATGGCAGTAGAGTAGGTTTTTTCAGTCTTGGCTTGGACTTTTCTCCCATCCA  
AGGTGGACATGGAAATATTGAATTTTTAGCGTATTGAAAAAAGAAAAGTCAGCAAGCAATCAGATTCT  
TGCTGAGATTAAAGAAGCAGTAGAGAGGGCGCATAGTCAATTTAAAAATGAA

**SP041 amino acid (SEQ ID NO:64)**

AKERVDVLAYKQGLFETREQAKRGMAGLVVAVLNGERFDKPEKIPDDTELKLGKELKYVSRGGLKL  
EKALQVFDLSVDGATTIDIGASTGGFTDVMLQNSAKLVFAVDVGTNQLAWKLQDPRVVSMEQFNFRYA  
EKTDFEQEPSFASIDVSFISLSLILPALHRVLADQGVVALVKPQFEAGREQIGKNGIIRDAKVHQNVL  
ESVTAMAVEVGFSVLGLDFSPIQGGHGNIEFLAYLKKEKSASNQILAEIKEAVERAHSQFKNE

**SP042 nucleotide (SEQ ID NO:65)**

TGTTCTTATGAACCTGGTCGTACCAAGCTGCTCAGGTTAAGAAAGAGTCTAATCGAGTTTCTTATAT  
AGATGGTGATCAGGCTGGTCAAAAAGGCAGAAAATGACACCAGATGAAGTCAGTAAGAGGGAGGGGAT  
CAACGCCGAACAAATNGTNATCAAGATTACGGATCAAGGTTATGTGACCTCTCATGGAGACCATTATCA  
TTACTATAATGGCAAGGTTCTTATGATGCCATCATCAGTGAAGAGCTCCTCATGAAAGATCCGAATTA  
TCAGTTGAAGGATTGAGACATTGTCAATGAAATCAAGGGTGGTTATGTCAATTAAGGTAACGGTAAATA  
CTATGNTACCTTAAGGATGCAGCTCATGCCGATAATATTCGGACAAAAGAAGAGATTAAACGTCAGAA  
GCAGGAACGCAGTCATAATCAACTCAAGAGCAGATAATGCTGTTGCTGCAGCCAGAGCCCAAGGACG  
TTATACAAACGGATGATGGGTATATCTTCAATGCATCTGATATCATTTGAGGACACGGGTGATGCTTATAT  
CGTTCTTCACGGCGACCATTACCATTACATTCCTAAGAATGAGTTATCAGCTAGCGAGTTAGCTGCTGC

Table 1

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AGAAGCCTATTGGAATGGGAAGCAGGGATCTCGTCCTTCTTCAAGTTCTAGTTATAATGCAAAATCCAGC  
TCAACCAAGATTGTGAGAGAACCAATCTGACTGTCACTCCAACCTATCATCAAAATCAAGGGGAAAA  
CATTTCAAGCCTTTTACGTGAATTGTATGCTAAACCCCTATCAGAACGCCATGTGGAATCTGATGGCCT  
TATTTTCGACCCAGCGCAAATCACAAGTCGAACCGCCAGAGGTGTAGCTGTCCCTCATGGTAACCATTA  
CCACTTTATCCCTTATGAACAAATGTCTGAATTGGAAAAACGAATTGCTCGTATTATCCCTTCGTTA  
TCGTTCAAACCATTTGGGTACCAGATTCAAGACCAGAACCAAGTCCACAATCGACTCCGGAACCTAG  
TCCAAGTCCGCAACCTGCACCAATCCTCAACCAGCTCCAAGCAATCCAATTGATGAGAAATTTGGTCAA  
AGAAGCTGTTGCAAAAGTAGGCGATGGTTATGTCTTTGAGGAGAATGGAGTTTCTCGTTATATCCAGC  
CAAGGATCTTTGAGCAGAAACAGCAGCAGGCATTGATAGCAAACTGGCCAAGCAGGAAAGTTTATCTCA  
TAAGCTAGGAGCTAAGAAAACCTGACCTCCCATCTAGTGATCGAGAATTTTACAATAAGGCTTATGACTT  
ACTAGCAAGAATTCACCAAGATTTACTTGATAATAAAGGTCGACAAGTTGATTTTGAGGCTTTGGATAA  
CCTGTTGGAACGACTCAAGGATGTGCAAGTGAATAAGTCAAGTTAGTGGANGATATTCTTGCCTTCTT  
AGCTCCGATTCGTATCCAGAACGTTTAGGAAAACCAATGCGCAAAATACCTACACTGATGATGAGAT  
TCAAGTAGCCAAGTTGGCAGGCAAGTACACAACAGAAGACGGTTATATCTTTGATCCTCGTGATATAAC  
CAGTGATGAGGGGATGCCTATGTAACCTCCACATATGACCCATAGCCACTGGATTAAGAAAGATAGTTT  
GTCTGAAGCTGAGAGAGCGGAGCCAGGCTTATGCTAAAGAGAAAGGTTTGACCCCTCCTTCGACAGA  
CCATCAGGATTCAGGAAATACTGAGGCAAAAGGAGCAGAAGCTATCTACAACCGCGTGAAAGCAGCTAA  
GAAGGTGCCACTTGATCGTATGCCTTACAATCTTCAATATACTGTAGAAGTCAAAAACGGTAGTTTAAT  
CATACCTCATTATGACCATTAACATAACATCAAATTTGAGTGGTTTGACGAAGGCTTTATGAGGCACC  
TAAGGGGTATACTCTTGAGGATCTTTTGGCGACTGTCAAGTACTATGTGCAACATCCAAACGAACGTCC  
GCATTAGATAATGGTTTGGTAACGCTAGCGACCATGTTCAAAGAAAACAAAATGGTCAAGCTGATAC  
CAATCAAACGGGAAAAACCAAGCGAGGAGAAACCTCAGACAGAAAAACCTGAGGAAGAAACCCCTCGAGA  
AGAGAAACCGCAAAGCGAGAAACAGAGTCTCCAAAACCAACAGAGGAACCAAGAATCACAGAGGA  
ATCAGAAGAACCTCAGGTCGAGACTGAAAAGGTTGAAGAAAACCTGAGAGAGGCTGAAGATTTACTTGG  
AAAAATCCAGGAT

**SP042 amino acid (SEQ ID NO:66)**

CSYELGRHQAGQVKESNRVSYIDGDQAGQKAENLTPDEVSKREGINAEQXVIKITDQGYVTSBGDHYH  
YYNGKVPYDAIISEELMKDPNYQLKDSDIVNEIKGGYVIKVNKYYVYLKDAHADNIRTKKEIKRQK  
QERSHNHNSRADNAVAAAARAGRYTTDDGYIFNASDIIEDTGDAYIVPHGDHYHYIPKNELASELAAA  
EAYVNGKQGSRPSSSSSYNANPAQPRLSNHNLTVTPTYHQNGENISSLLRELYAKPLSERHVESDGL  
IFDPAQITSRTARGVAVPHGNHYHFIPYEQMSELEKRIARIIPLYRSNHWVPDSRPEQSPQSTPEPS  
PSPQAPNPQAPSPNPIDEKLVKEAVRKVG DG YVFEENGVSRYIPAKDLSAETAAGIDSKLAKQESLSH  
KLGAKKTDLPSSDREFYNKAYDLLARIHQDLDLNDKGRQVDFEALDNLRLKDVXSDKVKLVXDILAFI  
APIRHPERLKGPNQIYITDDEIQVAKLAGKYTTEDGYIFDPRDITSDEGDYVTPHMTSHWIKKDSL  
SEAERAAAQYAKEKGLTPPSTDHQDSGNTAKGAEAIYNRVKAAKVP LDRMPYNLQYTV EVKNGSLI  
IPHYDHYHNIKFEWFDEGLYEAPKGYTLEDLLATVKYVYEHNPNERPHSDNGFGNASDHVQRNKGQADT  
NQTEKPSSEKQTEKPEEETPREKQSEKPEPKPTTEPEESPEESEEPQVETEKVEEKLREAEDLLG  
KIQD

**SP043 nucleotide (SEQ ID NO:67)**

TTATAAGGGTGAATTAGAAAAAGGATACCAATTTGATGGTTGGGAAATTTCTGGTTTCGAAGGTAAAAA  
AGACGCTGGCTATGTTATTAATCTATCAAAAGATACCTTTATAAAACCTGTATTCAAGAAAAATAGAGGA  
GAAAAAGGAGGAAGAAAAATAACCTACTTTTGATGTATCGAAAAAGAAAGATAACCCACAAGTAAACCA  
TAGTCAATTAATGAAAGTCACAGAAAAAGAGGATTTACAAAGAGAAGAGCATTCACAAAAATCTGATTC  
AACTAAGGATGTTACAGCTACAGTTCTTGATAAAAAACAATATCAGTAGTAATCAACTACTAACAATCC  
TAATAAG

**SP043 amino acid (SEQ ID NO:68)**

YKGELEKGYQFDGWEISGFEGKKDAGYVINLSKDTFIKPVFKKIEEKKEEENKPTFDVSKKKDNPQVNH  
SQLNESHKEDLQREEHSQKSDSTKDVATVLDKNNISSKSTTNPNK

**SP044 nucleotide (SEQ ID NO:69)**

GAATGTTCAAGGTCAGAAAGTTCAGGAAATAAAATCCACTTTATCAATGTTCAAGAAGGTGGCAGTGA  
TGCGATTATTCTTGAAAGCAATGGACATTTTGCCATGGTGGATACAGGAGAAGATTATGATTTCCAGGA  
TGGAAGTGATTTCTCGCTATCCATGGAGAGAAGGAATTGAAACGCTTTATAAGCATGTTCTAACAGACCG  
TGCTTTTCGTGTTGAAAGGAATTGGGTGTCCAAAACTTGATTTTATTTTGGTGACCCATACCCACAG  
TGATCATATTGGAATGTTGATGAATTACTGTCTACCTATCCAGTTGACCGAGTCTATCTTAAGAAATA



Table 1

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TAGTGATAGTCGTATTACTAATTCTGAACGCTCTATGGGATAATCTGTATGGCTATGATAAGGTTTACAGACTGCTGCAGAAAAAGGTGTTTCAGTTATTTCAAAAATATCACACAAGGGGATGCTCATTTTCAGTTTGGGGACATGGATATTCAGCTCTATAATTATGAAAAATGAAACTGATTCATCGGGTGAATTAAGAAAAATTGCGGATGACAATTCCAATTCCTTGATTAGCGTGGTGAAAGTCAATGGCAAGAAAAATTACCTTGGGGCGGATTTAGATAATGTTTCATGGAGCAGAAGACAAGTATGGTCTCTCATTTGGAAAAAGTTGATTTGATGAAGTTTAATCATCACCATGATACCAACAAATCAAATACCAAGGATTTTCATTAATAAATTTGAGTCCGAGTTTGATTGTTCAAACCTTCGGATAGTCTACCTTGGAAAAATGGTGTGATAGTAGTATGTTAATTGGCTCAAAGACGAGGAATTGAGAGAAATCAACGCAGCCAGCAAAGACTATGATGCAACAGTTTTTGATATTCGAAAAAGACGGTTTTGTCAATATTTCAACATCCTACAAGCCGATTCCAAGTTTTCAAGCTGGTTGGCATAAGAGTGCATATGGGAACCTGGTGGTATCAAGCGCCTGATTCTACAGGAGAGTATGCTGTCGGTTGGAATGAAATCGAAGGTGAATGGTATTACTTTAACCACAAACGGGTATCTTGTACAGAAATCAATGGAAAAATGGAACAATCATTTGGTTCTATTGACAGACTCTGGTGTCTGCTAAAAATTTGGAAGAAAAATCGCTGGAATCTGGTATTAATTTAACAAGAAAAACAGATGGAAATTTGGTTGGATTCAAGATAAAGAGCAGTGGTATTATTTGGATGTGATGGTTCTATGAAGACAGGATGGCTTCAATATATGGGGCAATGGTATTACTTTGCTCCATCAGGGGA

**SP044 amino acid (SEQ ID NO:70)**

NVQAQESSGNKIHFINVQEGGSDAIIIESNGHFAMVDTGEDYDFPDGSDSRYPWREGIETSYKHVLTDRVFRRLKELGVQKLDLFIIVTHTHSDHIGNVDELLSTYPVDRVYLKKYSDSRITNSERLWDNLGYDKVLQTAAEKGVSVIIONITQGDHAFQFGDMIDIQLYNYENETDSSGELKKIWDNNSNLSISVVKVNGKKIYLGGLDNLVHGAEDKYGPLIGKVDLMKFNHHDNTKNSNTKDFIKNLSPLIVQTSDSLPLWKNVGDSEYVNWLEKRGIERINAASKDYDATVFDIRKDGFNISTSYKPIPSFQAGWHKSAYGNWWYQAPDSTGEYAVGWNEIEGEWYFFNQTGILLQNWKKWNNHWFYLTDSGASAKNWKIAGIWIYFNKENQMEIGWIQDKEQWYVLDVDGSMKTGWLQYMGQWYFAPS

**SP045 nucleotide (SEQ ID NO:71)**

CTTGGGTGTAACCCATATCCAGCTCCTTCCAGTCTGTCTTACTACTTTGTCAATGAATTGAAAAACCATGAACGCTTGTCTGACTACGCTTCAAGCAACAGCAACTACAACCTGGGGATATGACCCCTAAAACCTACTTCTCCTTGACTGGTATGTACTCAAGCGATCCTAAGAATCCAGAAAAACGAATCGCAGAAATTTAAAAACCTCATCAACGAAATCCACAAACGCTGGTATGGGAGCTATCCTAGATGTCGTTTATAACCACACAGCCAAAGTCGATCTCTTTGAAGATTTGGAACCAAACTACTACCCTTTATGGATGCCGATGGCACACCTCGAAGCTAGCTTTGGTGGTGACGCTTGGGGACAACCCACCATATGACCAAAACGGCTCCTAATTGACTCTATCAAAATACCTAGTTGATACCTACAAAGTGGATGGCTTCCGTTTCGATATGATGGGAGACCATGACGCCGCTCTATCGAAGAAGCTTACAAGGCTGCACGCGCCCTCAATCCAAACCTCATATGCTTGGTGAAGGTTGGAGAACCTATGCCGGTGATGAAAAACATGCCTACTAAAGCTGCTGACCAAGATTGGATGAAACATACCGATACTGTGCTGTCTTTTCAGATGACATCCGTAACAACCTCAAACTCTGGTTATCCAAACGAAGGTCAACCTGCCTTTATCACAGGTGGCAAGCGTGATGTCAACACCATCTTTAAAAATCTCATTGCTCAACCACTAACTTTGAGCTGACAGCCCTGGAGATGTCAATCAATACATCGCAGCCATGATAACTTGACCTCTTTGACATCATTGCCCCAGTCTATCAAAAAAGACCCAAGCAAGGCTGAGAACTATGCTGAAATCCACCGTCGTTTACGACTTGGAATCTCATGGTCTTGACAGCTCAAGGAACTCCATTTATCCACTCCGGTCAGGAATATGGACGTACTAAACAAATCCCGTGACCCAGCCTACAAGACTCCAGTAGCAGAGGATAAGGTTCCAAACAAATCTCACTGTTCGCTGATAAGGACGGCAACCCATTTGACTATCCTTACTTTCATCCATGACTCTTACGATTCTAGTGATGCAGTCAACAAGTTTGAAGTGAAGCTACAGATGGTAAAGCTTATCCTGAAAAATGTCAAGAGCCGTGACTATATGAAAGGTTTGAATGTCCTTCCGTCATCTACAGATGCTTCCGACTTAAGAGTCTTCAAGATATCAAGACCGTGTCCACCTCATCACTGTCCAGGCCAAAAATGGTGTGAAAAAGAGGATGTAGTGATGGCTACCAAAATCACTGCTCCAAACGGCGATATCTACGAGTCTTTGTCAATGCGGATGAAAAAGCTCGCGAATTTAATTTGGGAATGCCTTTGCACATCTAAGAAATGCGGAAGTTTGGCAGATGAAAAACCAAGCAGGACAGTCGGAATTGCCAACCCGAAAGGACTTGAATGGACTGAAAAAGGCTTGAAATGAATGCCCTTACAGCTACTGTTCTTCGAGTCTCTCAAAATGGAAGTACCATGAGTCAACTGCAGAGAGAAACCCAGACTCAACCCCTTCCAAAGCCTGAACATCAAAATGAAGCTTCTCACCTTGACATCAAGACCCAGCTCCAGAGCTAGACCTGATTCTACTAAACCAGATGCCAAAGTAGCTGATGCGGAAAAATAAACCTAGCCAAGCTACAGCTGATTACAAGCTGAACAACAGCACAAGAAGCACAAGCATCATCTGTAAAGAAGCGGTTTCAAGACGAATCGGTAGAAAACTCTAGCAAGGAAAAATATACCTGCAACCCAGATAAACAAGCTGAA

**SP045 nucleotide (SEQ ID NO:72)**

LGVTHIQLLPVLVSYFVNELKNHERLSDYASSNSNYNWGYDPQNYFSLTGMYSDDPKNPEKRIAEFKNLINIEHKRGMGAILDVVYNHTAKVDLFEDLEPNYHFMDADGTPRTSFGGRLGTHHMTKRLLLDSIKYLVDITYKVDGFRFDMMDHDAASIEEYKAARALNPNLIMLGEWRTYAGDENMPTKAADQDWMKHTDTV

Table 1

AVFSDDIRNNLKS GYPNEGQPAFITGGKRDVNTIFKNLIAQPTNFEADSPGDVIQYIAAHDNLTLFDII  
AQSIKKDPSKAENYAEIHRRLRLGNLMVLTAQGTFFIHSQGEYGRTKQFRDPAYKTPVAEDKVPNKSHL  
LRDKDGNPFDPYFIHDSYDSSDAVNKFDWTKATDGKAYPENVKSRDYMKGILALRQSTDAFRLKSLQD  
IKDRVHLITVPGQNGVEKEDVIGYQITAPNGDIYAVFVNADEKAREFNLGTAF AHLRNAEVLADENQA  
GPVGIANPKGLEWTEKGLKLNALTATVLRVSONGTSHESTAEKPDSTPSKPEHQNEASHPAHQDPAPE  
ARPDSTKPKDAKVADAENKPSQATADSQAEQPAQEAQASSVKEAVRNESVENSSENIPATPKQAE

**SP046 nucleotide (SEQ ID NO:73)**

TAGTGATGGTACTTGGCAAGGAAAACAGTATCTGAAAGAAGATGGCAGTCAAGCAGCAAATGAGTGGGT  
TTTNGATACTCATTATCAATCTTGGTTCTATATAAAAGCAGATGCTAACTATGCTGAAAATGAATGGCT  
AAAGCAAGGTGACGACTATTTTACCTCAAATCTGGTGGCTATATGGCCAAATCAGAAATGGGTAGAAGA  
CAAGGGAGCCTTTTATTATCTTGACCAAGATGGAAGATGAAAAGAAATGCTTGGGTAGGAACCTTCCTA  
TGTTGGTGCAACAGGTGCCAAAGTAATAGAAGACTGGGTCTATGATTCTCAATACGATGCTTGGTTTAA  
TATCAAAGCAGATGGACAGCACGACAGAGAAAGAAATGGCTCCAAATTAAGGGAAGGACTATTATTTCAA  
ATCCGGTGGTTATCTACTGACAAGTCAGTGGATTAATCAAGCTTATGTGAATGCTAGTGGTGCCAAAGT  
ACAGCAAGGTTGGCTTTTGGACAAACAATACCAATCTTGGTTTACATCAAAGAAAATGGAACATATGC  
TGATAAAGAATGGATTTTCGAGAATGGTCACTATATTATCTAAATCCGGTGGCTACATGGCAGCCAA  
TGAATGGATTTGGGATAAGGAATCTTGGTTTATCTCAAATTTGATGGGAAAATGGCTGAAAAGAATG  
GGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCCGGTGGTTACATGACAGCCAAATGAATG  
GATTCTGGGATAAGGAATCTTGGTTTACCTCAAATCTGATGGGAAAATAGCTGAAAAGAATGGGTCTA  
CGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCTGGTGGCTACATGGCGAAAATGAGACAGTAGA  
TGGTTATCAGCTTGGAGCGATGGTAAATGGCTTGGAGGAAAATACAAATGAAAATGCTGCTTACTA  
TCAAGTAGTGCTGTTCAGCCAAATGTTTATGATTCAGATGGTGAAAAGCTTTCCTATATATCCCAAGG  
TAGTGTCGTATGGCTAGATAAGGATAGAAAAGTGATGACAAGCGCTTGGCTATTACTATTTCTGGTTT  
GTCAGGCTATATGAAAACAGAAGATTACAAGCGCTAGATGCTAGTAAGGACTTTATCCCTTATTATGA  
GAGTGATGGCCACCGTTTATCTACTATGTGGCTCAGAATGCTAGTATCCAGTAGCTTCTCATCTTTC  
TGATATGGAAGTAGGCAAGAAATATTATTCGGCAGATGGCTGCATTTTGATGGTTTAAAGCTTGAGAA  
TCCCTTCTCTTTCAAAGATTTAACAGAGGCTACAACTACAGTGTGAAGAATTGGATAAGGATATTTAG  
TTTGCTAAACATTAAACAATAGCCTTTTGGAGAACAAGGGCGCTACTTTTAAGGAAGCCGAAGAACATTA  
CCATATCAATGCTCTTTATCTCTTGGCCATAGTGCCTAGAAAAGTAAGTGGGGAAGAAGTAAATATGC  
CAAAGTAAAGAAATATTCTTTGGCATTACAGCCTATGATACGACCCCTTACCTTTCTGCTAAGACATT  
TGATGATGTGGATAAAGGAATTTAGGTGCAACCAAGTGATTAAGGAAAATTATATCGATAGGGGAAG  
AACTTTCTTGGAAAACAAGGCTTCTGGTATGAATGTGGAATATGCTTCAGACCCCTTATGGGGCGAAAA  
AATTGCTAGTGTGATGATAAATCAATGAGAAGCTAGGTGGCAAAGAT

**SP046 amino acid (SEQ ID NO:74)**

SDGTWQKQYLYKEDGSQAANEWVXDTHYQSWFYIKADANYAENEWLKQDDYFYLKSGGYMAKSEWVED  
KGAFYYLDQDGMKRNWVGTSYVGATGAKVIEDWVDSQYDAWFYIKADGQHAKEWLQIKGKDYFFK  
SGGYLLTSQWINQAYVNASGAKVQGWLFQKQYQSWFYIKENGYADKEWIFENGHYLYLKSGGYMAAN  
EWIWDKESWFYLFQDGMKAEKEWVYDSHSQAWYFYSKSGGYMTANEWIWDKESWFYLFKSDGKIAKEWVY  
DSHSQAWYFYSKSGGYMAKNETVDGYQLGSDGKWLGGKTTNENAAYYQVVPVTANVYDSGDEKLSYISQ  
SVVWLDKDRKSDDKRLAITISGLSGYMKTEDLQALDASKDFIPYYESDGHFRFYHYVAQNASIPVASHLS  
DMEVGKYYKYSADGLHFDGFKLENPFLFKDLTEATNYSAEELDKVFSLLNINNSLLENKGATFKEAEEHY  
HINALYLLAHSALSNWGRSKIAKDKNFFGITAYDTPYLSAKTFDDVDKGILGATKWIKENYIDRGR  
TFLGNKASGMNVEYASDPYWGKIASVMMKINEKLGGKD

**SP048 nucleotide (SEQ ID NO:75)**

TGGGATTCAATATGTCAGAGATGATACTAGAGATAAAGAAGAGGGAATAGAGTATGATGACCGTGACAA  
TGGGGATATTATTGTAAAGTAGCGACTAAACCTAAGGTAGTAACCAAGAAAATTTCAAGTACGCGAAT  
TCGTTATGAAAAGATGAAACAAAAGACCGTAGTGAATCTCTGTTACAATTGATGGAGAGGATGGCTA  
TGTAACACGACAAGGACCTACGATGTTAATCCAGAGACTGGTTATGTTACCGAACAGGTTACTGTTGA  
TAGAAAAGAAGCCACGGATACAGTTATCAAAGTTCAGCTAAAAGCAAGGTTGAAGAAGTCTCTGTTCC  
ATTTGCTACTAAATATGAAGCAGACAATGACCTTTCTGCAGGACAGGAGCAAGAGATTACTCTAGGAAA  
GAATGGGAAAACAGTTACAACGATAACTTATAATGTAGATGGAAGAGTGGACAAGTAAGTACGAGTAC  
TTTAAGTCAAAAAAAGACTCTCAAACAAGAGTTGTTAAAAAAGAACCAATKCCCCAAGTTCTTGTCCA  
AGAAATTCCAATCGAAACAGAAATATCTCGATGGCCCAACTCTTGATAAAAGTCAAGAAGTAGAAGAAGT  
AGGAGAAAATGGTAAATTACTCTTACTACAATCTATACTGCTAGATGAACGTGATGGAACAATTGAAGA  
AACTACTTCTCGTCAAATTACTAAAGAGATGGTAAAAAGAGCTATAAGGAGAGGGACGAGAGAACCTGA

Table 1

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AAAAGTTGTTGTTCCCTGAGCAATCATCTATTCCCTTCGTATCCTGTATCTGTACATCTAACCAAGGAAC  
AGATGTAGCAGTAGAACCAGCTAAAGCAGTTGCTCCAACAACAGACTGGAAACAAGAAAATGGTATGTG  
GTATTTTATAATACTGATGGTTCATGGCAACAGGTTGGGTACAAGTTAATAGTTTCATGGTACTACCT  
CAACAGCAACGGTTCATGAAAGTCAATCAATGGTTCCAAGTTGGTGGTAAATGGTATATGTAAATAC  
ATCGGGTGAGTTAGCGGTCAATACAAGTATAGATGGCTATAGAGTCAATGATAATGGTGAATGGGTGCG  
T

**SP048 amino acid (SEQ ID NO:76)**

GIQYVRDDTRDKEEGIEYDDADNGDIIVKVATKPKVVTKKISSSTRIRYEKDETKDRSENPVITIDGEDGY  
VTTTRTYDVNPETGYVTEQVTVDRKEATDVIKVPKSKVEEVLVPFATKYEADNDLSAGQEIEITLGK  
NGKTVTTITYNVGKSGQVTESTLSQKKDSQTRVVKKRTXPQVLVQEIPIETEYLDGPTLDKSGQEVEEV  
GEIGKLLLLQSILVDERDGTIEETTSRQITKEMVKRRIRRGTREREKVVVPEQSSIPSYPVSVTSNQGT  
DVAVEPAKAVAPTDDWKQENGMWYFYNTDGSMTGWVQVNSSWYYLNSNGSMKVNQWFQVGGKWYYVNT  
SGELAVNTSIDGYRVNDNGEWVR

**SP049 nucleotide (SEQ ID NO:77)**

GGATAATAGAGAAGCATTAAAAACCTTTATGACGGGTGAAAATTTTATCTCCAACATTATCTAGGAGC  
ACATAGGGAAGAACTAAATGGAGAGCATGGCTATACCTTCCGTGTTTGGGCACCTAATGCTCAGGCTGT  
TCACTTGGTTGGTGATTTTACCAACTGGATTGAAAATCAGATTCCAATGGTAAGAAATGATTTTGGGGT  
CTGGGAAGTCTTTACCAATATGGCTCAAGAAGGGCATATTTACAAATATCATGTACACAGTCAAAATGG  
TCATCAACTGATGAAGATTGACCTTTTGCTGTGAGGTATGAGGCTCGTCCAGGAACAGGGGCAATCGT  
AACAGAGCTTCTGAGAAGAAATGGAAGGATGGACTTTGGCTGGCAGGAAGAAACGTTGGGGCTTTGA  
AGAGCGTCTGTCAATATTTATGAAGTTCACGCTGGATCATGGAAAAGAAATCTGATGGCAGTCCTTA  
TAGTTTTGCCAGCTCAAGGATGAATCATCTTATCTCGTTGAAATGAATATACTCATATTGAGTT  
TATGCCCTTGATGTCCCATCTTTGGGCTTGAGTTGGGGTATCAGCTTATGGGTACTTTCGCTTTAGA  
CGATGCTTATGGCCGACCAGAGGAGTTTCAAGATTTTGTC

**SP049 amino acid (SEQ ID NO:78)**

DNREALKTFMTGENFYLLQHYLGAREELNGEHGYTFRVWAPNAQAVHLVGDFTNWIENQIPMVRNDFGV  
WEVFTNMAQEGHIYKHVTRQNGHQLMKIDPFAVRYEARPGTGAIVTELPKKWKDGLWLARRKRWGF  
ERPVNIEVHAGSWKRNSDGSFSAQLKDELIPYLVMNMYTHIEFMPLMSHPLGLSWGQYQLMGYFALE  
HAYGRPEEFQDFV

**SP050 nucleotide (SEQ ID NO:79)**

AGATTTTGTGCGAGGAGTGTCATACCCATAATATTGGGGTTATTGTGGACTGGGTACCAGNTCACTTTAC  
CATCAACGATGATGCCCTTAGCCTATTATGATGGGACACCGACTTTTGAATACCAAGACCATAATAAGGC  
TCATAACCATGGTTGGGGTGCCCTTAATTTTGACCTTGAAAAAATGAAGTCCAGTCTTCTTAAATTTT  
TTGCATTAAAGCATTGGATTGATGTCTATCATTTGGATGGTATTCGTGTGGATGCTGTTAGCAACATGCT  
CTATTTGGACTATGATGATGCTCCATGGACACCTAATAAAGATGGCGGAAATCTCAACTATGAAGGTTA  
TTATTTCTTCAGCGCTTGAATGAGGTTATTAAAGTTAGAATATCCAGATGTGATGATGTCAGAAGA  
AAGTTCGCTGCGATCAAGATTACGGGAATGAAAGAGATTGGTGGTCTAGGATTTGACTACAAATGGAA  
CATGGGCTGGATGAATGATATCCTCCGTTTCTACGAAGAAGATCCGATCTATCGTAAATATGACTTTAA  
CCTGGTGACTTTCAGCTTTATGATGTTTNCAGGAGAATTATCTCTTGCCATTCTCGCAGCATGAAGT  
GGTTCATGGCAAGAAGAGTATGATGCATAAGATGTGGGGAGATCGTTACAATCAATTCGACAGGCTTGCG  
CAATCTCTATACGTACCAAAATTTGTCAACCCTGGTAAGAAATTGCTCTTCATGGGTAGCGAATACGGTCA  
ATTCTTAGAATGGAATCTGAAGAACAGTTGGAATGGTCTAACCTAGAAGACCAATGAATGCTAAGAT  
GAAGTATTTTCGCTTCTCAGCTAAACCAGTTTACAAAGATCATCGCTGTCTGTGGGAAATGATACCAG  
CTATGATGGTATTGAAATCATTGATGCGGATAATCGAGACCAGAGTGTCTTTCTTTTATTCGTAAGGG  
TAAAAAGGGA

**SP050 amino acid (SEQ ID NO:80)**

DFVEECHTHNIGVIVDVVPXHFTINDDALAYYDGTPTFEYQDHNKAHNHGWGALNFDLGKNEVQSFLIS  
CIKHWDIVYHLDGIRVDVSNMLYLDYDDAPWTPNKGNNLYEGYYFLQRLNEVIKLEYPDVMMAEE  
SSSAIKITGMKEIGGLGFDYKWNMGWMNDILRFYEEDPIYKYDFNLVTF SFMYVXKENYLLPFSHDEV  
VHGKKSMMHKMWGDRYNQFAGLRNLYTYQICHPGKLLFMGSEYGFLEWKSEEQLEWSNLEDPMNAKM  
KYFASQLNQFYKDHRLWEIDTSYDGIIEIDADNRDQSVLSFIRKGGK

**SP051 nucleotide (SEQ ID NO:81)**

Table 1

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ATCTGTAGTTTATGCGGATGAAACACTTATTACTCATACTGCTGAGAAACCTAAAGAGGAAAAAATGAT  
AGTAGAAGAAAAGGCTGATAAAGCTTTGGAAACTAAAAATATAGTTGAAAGGACAGAACAAAGTGAACC  
TAGTTCAACTGAGGCTATTGCATCTGAGNAGAAAGAAGTGAAGCCGTAACCTCCAAAAGAGGAAAAAGT  
GTCTGCTAAACCGGAAGAAAAAGCTCCAAGGATAGAATCACAAGCTTCAAATCAAGAAAAACCGCTCAA  
GGAAGATGCTAAAGCTGTAACAAATGAAGAAGTGAATCAAATGATTGAAGACAGGAAAGTGGATTTTAA  
TCAAAATTGGTACTTTAAACTCAATGCAAATTCTAAGGAAGCCATTAAACCTGATGCAGACGTATCTAC  
GTGGAAAAAATTAGATTACCGTATGACTGGAGTATCTTTAACGATTTCGATCATGAATCTCTCTGCACA  
AAATGAAGGTGGACAGCTCAACGGTGGGGAAGCTTGGTATCGCAAGACTTTCAAACCTAGATGAAAAAGA  
CCTCAAGAAAAATGTTTCGCCCTTACTTTTGTATGGCGTCTACATGGATTCTCAAGTTTATGTCAATGGTCA  
GTTAGTGGGGCATTTATCCAAATGGTTATAACCAAGTTCTCATATGATATCACCAAATACCTTCAAAAAGA  
TGGTCTGTGAGAAATGTGATTGCTGTCCATGCAGTCAACAAACAGCCAAAGTAGCCGTTGGTATTGAGGAAG  
TGGTATCTATCGTGATGTGACTTTACAAGTGACAGATAAGGTGCATGTTGAGAAAAATGGGACAACTAT  
TTTAACACCAAACTTGAAGAACAACAATGGCAAGGTTGAAACTCATGTGACCAGCAAAATCGTCAA  
TACGGACGACAAGACCATGAACCTGTAGCCGAATATCAAATCGTTGAACGAGGTGGTCAATGCTGTAAC  
AGGCTTAGTTCTGACAGCGAGTCGTACCTTAAAAGCACATGAATCAACAAGCCTAGATGCGATTTTAGA  
AGTTGAAAGACCAAACTCTGGACTGTTTAAATGACAAACCTGCCTGTACGAATTGATTACGCGTGT  
TTACCGTGACGGTCAATTGGTTGATGCTAAGAAGGATTGTTTGGTTACCGTTACTATCACTGGACTCC  
AAATGAAGGTTTCTCTTTGAATGGTGAACGTATTAATTCATGGAGTATCCTTGCACCACGACCATGG  
GGCGCTTGGAGCAGAAGAAAACTATAAAGCAGAATATCGCCGCTCTCAAAACAAATGAAGGAGATGGGAGT  
TAACTCCATCCGTACAACCCACAACCCCTGCTAGTGAGCAACCTTGCAAAATCGCAGCAGAACTAGGTTT  
ACTCGTTGAGGAAGAGGCCCTTTGATACGTGGTATGGTGGCAAGAAACCTTATGACTATGGACGTTTCTT  
TGAAAAAGATGCCACTCACCCAGAAGCTCGAAAAAGGTGAAAAATGGTCTGATTTTGACCTACGTACCAT  
GGTCAAGAGAGGCAAAAACAACCCCTGCTATCTTCAATGTTGGTCAATTGGTAATGAAATAGGTGAAGCTAA  
TGGTGATGCCACTCTTTAGCAACTGTTAAACGTTTGGTTAAGGTTATCAAGGATGTTGATAAGACTCG  
CTATGTTACCATGGGAGCAGATAAAATTCGGTTTCCGTAATGGTAGCGGAGGGCATGAGAAAAATGCTGA  
TGAACCTCGATGCTGTTGGATTAACTATTCTGAAGATAATTACAAAGCCCTTAGAGCTAAGCATCCAAA  
ATGGTTGATTTATGGATCAGAAACATCTTCAGCTACCCGTACAGTGGAAAGTTACTATCGCCCTGAACG  
TGAAATGAAACATAGCAATGGACCTGAGCGTAATTATGAACAGTCAGATTATGGAAATGATCGTGTGGG  
TTGGGGGAAAAACAGCAACCGCTTTCATGGACTTTTGACCGTGACAACGCTGGCTATGCTGGACAGTTTAT  
CTGGACAGGTACGGACTATATTGGTGAACCTACACCATGGCACAACCAAAATCAAACCTCCTGTTAAGAG  
CTCTTACTTTGGTATCGTAGATACAGCCGGCATTCCAAAACATGACTTCTATCTCTACCAAAGC

**SP051 amino acid (SEQ ID NO:82)**

SVVYADETLITHAEKPKKEKMIVEEKADKALETKNIVERTEQSEPSSTEAIASEXKEDEAVTPKEEKV  
SAKPEEKAPRIESQASNQEKPLKEDAKAVTNEEVNQMIEDRKVDFNQNWYFKLNANSKEAIKPDADVST  
WKKLDLPYDWSIFNDFDHPAQNEGGQLNGGEAWYRKTFKLDEKDLKKNVRLTFDGVYMDSQVYVNGQ  
LVGHYPNGYNQFSYDITKYLQKDGRENVIHAVHNKQPSSRWYSGSGIYRDVTLQVTDKVVHEKNGTTI  
LTPKLEEQQHKGKVEHVTSKIVNTDDKDHELVAEYQIVERGGHAVTGLVRTASRTLKAHESTSLDAILE  
VERPKLWTLVNDKPALYELITRVYRDGQLVDKDLFGYRYHWTNPEGFSLNGERIKFHGVSLHHDHG  
ALGAEENYKAEYFRLKQMKEMGVNSIRTTNHPASEQTLQIAAELGLLVQEEAFDTWYGGKKPYDYGRFF  
EKDATHPEARKGEKWSDFDLRTMVERGKNNPAIFMWSIGNEIGEANGDAHSLATVKRLVKVIKDVDKTR  
YVTMGADKFRFGNGSGGHEKIADELDAVGFNYSEDNYKALRAKHPKWLIIYGSETSSATRTGRSYRPER  
ELKHSNGPERNYEQSDYGNDRVGVGKTATASWTFDRDNAGYAGQFIWTGTDYIGEPTPWHNQNTPVKS  
SYFGIVDTAGIPKHDFYLYQS

**SP052 nucleotide (SEQ ID NO:83)**

TTACTTTGGTATCGTAGATACAGCCGGCATTCCAAAACATGACTTCTATCTCTACCAAAGCCAATGGGT  
TTCTGTTAAGAAGAAACCGATGGTACACCTTCTTCTCACTGGAACCTGGGAAAAACAAAGAAATTAGCATC  
CAAAGTAGCTGACTCAGAAGGTAAGATTCCAGTTTCGTGCTTATTCGAATGCTTCTAGTGTAAGAAATTGTT  
CTTGAATGGAAAATCTCTTGGTCTTAAAGACTTTCAATAAAAAACAAACCAGCGATGGGCGGACTTACCA  
AGAAGGTGCAAAATGCTAATGAACCTTTATCTTGAATGGAAAGTTGCCTATCAACCAGGTACCTTGGAAAGC  
AATTGCTCGTGATGAATCTGGCAAGGAAATTTGCTCGAGATAAGATTACGACTGCTGGTAAGCCAGCGGC  
AGTTCTGCTTTATTAAGGAAGACCATGCGATTGCAGCAGATGGAAAAGACTTGACTTACATCTACTATGA  
AATTGTTGACAGCCAGGGGAATGTGGTTCCAACCTGCTAATAATCTGGTTTCGCTTCCAATTGCTATGGCCA  
AGGTCAACTGGTCTGGTGTAGATAACGGGAGAACAGCCAGCCGTGAACGCTATAAGGCGCAAGCAGATGG  
TTCTTGGATTCTGTAAGCATTTAATGGTAAAGGTGTTGCCATTGTCAAATCAACTGAACAAGCAGGGAA  
ATTCAACCTGACTGCCCACTCTGATCTCTTGAATCGAACCAAGTCACTGTCTTACTGGTAAGAAAGA  
AGGACAAGAGAAGACTGTTTTGGGGACAGAAAGTGCCAAAAGTACAGACCATTATTGGAGAGGCACCTGA

Table 1

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AATGCCTACCACTGTTCCGTTTGTATACAGTGATGGTAGCCGTGCAGAACGTCCTGTAACCTGGTCTTC  
AGTAGATGTGAGCAAGCCTGGTATTGTAACGGTGAAAGGTATGGCTGACGGACGAGAAGTAGAAGCTCG  
TGTAAGAGTATTGCTCTTAAATCAGAGCTACCAAGTTGTGAAACGTATTGCTCCAAATACGACTTGAA  
TTCTGTAGACAAATCTGTTTCTATGTTTGTATTGATGGAAGTGTGTAAGAGTATGAAGTGGACAAGTG  
GGAGATTGCCGAAGAAGATAAAGCTAAGTTAGCAATTCCAGGTTCTCGTATTCAAGCGACCGGTTATTT  
AGAAGGTCAACCAATTCATGCAACCCTTGTGGTAGAAGAAGGCAATCCTGCGGCACCTGCAGTACCAAC  
TGTAACGGTTGGTGGTGAGGCAGTAACAGGCTTACTAGTCAAAAACCAATGCAATACCGCACTCTTGC  
TTATGGAGCTAAGTTGCCAGAAGTCACAGCAAGTGCTAAAAATGCAGCTGTTACAGTTCTTCAAGCAAG  
CGCAGCAACGGCATGCGTGCAGCATCTTTATTACGCTTAAAGATGGTGGCCCTCTTCAAACCTATGC  
AATTCAATTCTTGAAGAAGCGCCAAAAATTGCTCACTTGAGCTTGAAGTGGAAAAAGCTGACAGTCT  
CAAAGAAGACCAAACTGTCAAATTGTCGGTTCGAGCTCACTATCAAGATGGAACGCAAGCTGTATTACC  
AGCTGATAAAGTAACCTTCTCTACAAGTGGTGAAGGGGAAGTCGCAATTCGTAAAGGAATGCTTGAGTT  
GCATAAGCCAGGAGCAGTCACTCTGAACGCTGAATATGAGGGAGCTAAAGACCAAGTTGAACCTCACTAT  
CCAAGCCAACTACTGAGAAGAAGATTGCGCAATCCATCCGTCCTGTAAATGTAGTGACAGATTGTCATCA  
GGAACCAAGTCTTCCAGCAACAGTAACAGTTGAGTATGACAAAGGTTTCCCTAAAACCTATAAAGTCAC  
TTGGCAAGCTATTCCGAAAGAAAACTAGACTCCTATCAAACATTTGAAGTACTAGGTAAGTTGAAGG  
AATTGACCTTGAAGCGCGTGCAAAAGTCTCTGTAGAAGGTATCGTTTCAAGTGAAGAAGTCAGTGTGAC  
AACTCCAATCGCAGAAGCACCACAATTACCAGAAAGTGTTCGGACATATGATTCAAATGSTCACGTTTC  
ATCAGCTAAGGTTGCATGGGATGCGATTCTGTCAGAGCAATACGCTAAGGAAGGTGCTTTTACAGTTAA  
TGGTCGCTTAGAAGGTACGCAATTAACA

**SP052 amino acid (SEQ ID NO:84)**

YFGIVDTAGIPKHDFLYQSQWVSVKKKPMVHLLPHWNWENKELASKVADSEGKIPVRAYSNAASSVELF  
LNGKSLGLKTFNKKQTS DGRTYQEGANANELYLEWKVAYQPGTLEAIARDESGKEIARDKITTAGKPAA  
VRLIKEDHAI AADGKDLTYIYYEIVDSQGNVPTANNLVRFLHQGQQLVGVDNGEQASRERYKAQADG  
SWIRKAFNGKGVAIVKSTEQAGKFTLTAHSDLLKSNQVTVFTGKKEGQEKTVLGTVEVPKVQTI IGEAPE  
MPTTVPFVYSDGSRAERPVTWSSVDVSKPGIVTVKGMADGREVEARVEVIALKSELPPVKRIAPNTDLN  
SVDKSVSYVLIDGSVEEYEVDKWEIAEEDKAKLAIPGSRIQATGYLEGQPIHATLVVEEGNPAAAPVPT  
VTVGGEAVTGLTSQKPMQYRTLAYGAKLPEVTASAKNAAVTVLQASAANGMRASIFIQPKDGGPLQTYA  
IQFLEAPKIAHLSLQVEKADSLKEDQTVKLSVRAHYQDGTQAVLPADKVTFSTSGEGEVAIRKGMLEL  
HKPGAUTLNAEYEGAKDQVELTIQANTEKKIAQSIRPVNVVTDLHQEPSLPATVTVEYDKGFPKTHKVT  
WQAIPEKLDSTYQTFEVLGKVEGIDLEARAKVSVVEGIVSVEEVSVTTPIAEAPQLPESVRTYDSNGHVS  
SAKVAWDAIRPEQYAKEGVFTVNGRLEGTQLT

**SP053 nucleotide (SEQ ID NO:85)**

AGCTAAGGTTGCATGGGATGCGATTTCGTCCAGAGCAATACGCTAAGGAAGGTGTCTTTACAGTTAATGG  
TCGCTTAGAAGGTACGCAATTAACAACCTAACTTCATGTTTCGCGTATCTGCTCAAACCTGAGCAAGGTGC  
AAACATTTCTGACCAATGGACCGGTTCCAGAAATGGCCACTTGCCTTTGCTTCAGACTCAAATCCAAGCGA  
CCCAGTTTCAAATGTTAATGACAAGCTCATTTCTTACAATAACCAACAGCCAATCGTTGGACAAACTG  
GAATCGTACTAAATCCAGAAGCTTCAGTCGGTGTCTGTTTGGAGATTACAGGTATCTTGAGCAACCGCTC  
CGTTGATAATCTAAGTGTGCGATTCCATGAAGACCATGGAGTTGGTGTACCGAAGTCTTATGTGATTGA  
GTATTATGTTGGTAAGACTGTCCCAACAGCTCCTAAAAACCTAGTTTGTGTTGGTAATGAGGACCATGT  
CTTTAATGATTCTGCCAACTGGAAACAGTTACTAATCTAAAAGCCCCCTGCTCAACTCAAGGCTGGAGA  
AATGAACCACTTTAGCTTTGATAAAGTTGAAACCTATGCTGTTTCGTATTTCGATGGTTAAAGCAGATAA  
CAAGCGTGGAACGCTCATCACAGAGGTACAAATCTTTGCCGAAACAAGTTGCGGCAGCCAAGCAAGGACA  
AACAAGAATCCAAGTTGACGGCAAAGACTTAGCAAACTCAACCCTGATTTGACAGACTACTACCTTGA  
GTCTGTAGATGGAAAAGTTCCGGCAGTCACAGCAAGTGTAGCAACAATGGTCTCGCTACCGTCGTTCC  
AAGCGTTTCGTGAAGGTGAGCCAGTTTCGTGTCATCGCGAAAGCTGAAAAATGGCGACATCTTAGGAGAATA  
CCGTCTGCACTTCACTAAGGATAAGAGCTTACTTTCTATAAACCAAGTTGCTGCGGTTAAACAAGCTCG  
CTTGCTACAAGTAGGTCAAGCACTTGAATTGCCGACTAAGTTCCAGTTTACTTCACAGGTAAGACCGG  
CTACGAAACAAAAGACCTGACAGTTGAATTGGGAAGAAAGTTCCAGCGGAAAACTGACAAAAGCAGGTCA  
ATTTACTGTTTCAGGCGGTGTCCTTGGTAGTAACCTTGTGCTGAGATCACTGTACGAGTGACAGACAA  
ACTTGGTGAGACTCTTTCAGATAACCCCTAATATGATGAAAACAGTAACAGGCTTTGCTTCAGCAAC  
CAATGATATTGACAAAACCTCTCATGACCGCGTTGACTATCTCAATGACGGAGATCATTCAGAAAATCG  
TCGTTGGACAAACTGGTCCACCAACCATCTTCTAATCCAGAAGTATCAGCGGGTGTGATTTTCCGTGA  
AAATGGTAAGATTGTAGAACGGACTGTTACACAAGGAAAAGTTTCAGTTCTTTGACAGATAGTGGTACGGA  
TGCACCATCTAACTCGTTTGTAGAACGCTATGTCGGTCCAGAGTTTGAAGTGCCAACCTACTATTCAA  
CTACCAAGCCTACGACGACGACCATCCATTCAACAATCCAGAAAATGGGAAGCTGTCTTATCGTGC

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GGATAAAGACATTGCAGCTGGTGTGAAATCAACGTAACATTTAAAGCTATCAAAGCCAAAGCTATGAG  
 ATGGCGTATGGAGCGTAAAGCAGATAAGAGCGGTGTTGCGATGATTGAGATGACCTTCCTTGACCAAG  
 TGAATTGCCTCAAGAAAGCACTCAATCAAAGATTCTGTAGATGGAAAAGAACTTGCTGATTTTCGCTGA  
 AAATCGTCAAGACTATCAAATTACCTATAAAGGTCAACGGCCAAAAGTCTCAGTTGAAGAAAACATCA  
 AGTAGCTTCAACTGTGGTAGATAGTGGAGAAGATAGCTTTCCAGTACTTGTTCGCCTCGTTTCAGAAA  
 TGGAAAACAAGTCAAGGAATACCGTATCCACTTGACTAAGGAAAAACCAGTTTCTGAGAAGACAGTTGC  
 TGCTGTACAAGAAGATCTTCCAAAAATCGAATTTGTTGAAAAAGATTGGCATAACAAGACAGTTGAGAA  
 AAAAGATTCAACACTGTATCTAGGTGAAACTCGTGTAGAACAAGAAGGAAAAGTTGGAAAAGAACGTAT  
 CTTTACAGCGATTAACTCTGATGGAAGTAAGGAAGAAAACTCCGTGAAGTGGTAGAAGTTCCGACAGA  
 CCGCATCGTCTTGGTTGGAACCAACCAGTAGCTCAAGAAGCTAAAAAACCAAGTGTGAGAAAAAGC  
 AGATACAAAACCAATTGATTCAAGTGAAGCTAGTCAAATAATAAGCCAG

**SP053 amino acid (SEQ ID NO:86)**

AKVAWDAIRPEQYAKEGVFTVNGRLEGTQLTKLHVRSQAQTEQGANISDQWTGSELPLAFASDSNPDS  
 PVSNNVDKLI SYNNQPANRWTNWNRTNPEASVGVLFSGILSKRSVDNLSVGFHEDHGVGVPKSYVIE  
 YVVGKTVPTAPKNPSFVGNEDHVFND SANWKPVNTL KAPAQLKAGEMNHSFDK VETYAVRIRMV KADN  
 KRGT SITEVQIFAKQVAAAKQGQTRI QVDGKDLANFPDLTDY YLESVDGKVP AVTASVSNNGLATVVP  
 SVREGE PVRVIAKAENGDI LGEYRLHFTKDKSLLSHKPVA AVKQARLLQVQALELP TKVPVYFTGKDG  
 YETKDLTV EWEVPAENLT KAGQFTVRGRVLGSNLVAEITVRVTDKLG ETLSDNPNYDENS NQAFASAT  
 NDIDKNSHDRV DYLNDGDHSENRRWTNWSPTSSNPEVSAGVIFRENGKIVERTVTQGVQFFADSGTD  
 APSKLV LERYVGP EFEPVPTYYSNYQAYDADHPFNNPENWEAVPYRADKDIAAGDEINVT FKA IKA KAMR  
 WRMERKADKSGVAMIEMTF LAPSELQESTQSKILVDGKELADFAENRQDYQITYKQRPKVSVEENNQ  
 VASTVVD SGEDSF PVLVRLVSESGQVKEYRIHLTKEKPVSEKTVA AVQEDLPKIEFVEKDLAYKTVEK  
 KDSTLYLGETRVEQEGKVGERIFTAINPDGSKEEKLREVVEVPTDRIVLVGTPVAQEA KKPQVSEKA  
 DTKPIDSSEASQTNAQ

**SP054 nucleotide (SEQ ID NO:87)**

CTATCACTATGTAAATAAAGAGATTATTTACACAAGAAGCTAAAGATTTAATTACAGACAGGAAAGCCTGA  
 CAGGAATGAAGTTGTATATGGTTTGGTGTATCAAAAAGATCAGTTGCCTCAAACAGGGACAGAA

**SP054 amino acid (SEQ ID NO:88)**

YHYVNKEIIISQEA KDLIQTGKPDRNEVVYGLVYQKDQLPQTGTE

**SP055 nucleotide (SEQ ID NO:89)**

TGAGACTCCTCAATCAATAACAAATCAGGAGCAAGCTAGGACAGAAAACCAAGTAGTAGAGACAGAGGA  
 AGCTCCAAAAGAAGAGCACCTAAACAGAGAAGTCCAAAGGAAGAACCAAAATCGGAGGTAAACCC  
 TACTGACGACACCCTTCCTAAAGTAGAAGAGGGGAAAGAAGATTCAGCAGAACCAGCTCCAGTTGAAGA  
 AGTAGGTGGAGAAGTTGAGTCAAAACCAGAGGAAAGTAGCAGTTAAGCCAGAAAAGTCAACCATCAGA  
 CAAACCAGCTGAGGAATCAAAAAGTTGAACAAGCAGGTGAACCAGTCGCGCCAAGAGAAGACGAAAAGGC  
 ACCAGTCGAGCCAGAAAAGCAACCAGAAGCTCCTGAAGAAGAGAAGGCTGTAGAGGAAACACCGAAAACA  
 AGAAGAGTCAACTCCAGATACCAAGGCTGAAGAACTGTAGAACCAAAAGAGGAGACTGTTAATCAATC  
 TATTGAACAACCAAAAGTTGAAACGCCTGCTGTAGAAAAACAAACAGAACCACAGAGGAACCAAAAGT  
 TGAACAAGCAGGTGAACCAGTCGCGCCAAGAGAAGACGAACAGGCACCAACGGCACCAGTTGAGCCAGA  
 AAAGCAACCAAGAAGTTCTGAAGAAGAGAAGGCTGTAGAGGAAACACCGAAACCAAGAAGATAAAATAAA  
 GGGTATTGGTACTAAAGAACCAGTTGATAAAAGTGAGTTAAATAATCAAATTGATAAAGCTAGTTCAGT  
 TTCTCCTACTGATTAT

**SP055 amino acid (SEQ ID NO:90)**

ETPQSI TNQE QARTENQV VETEEAPKEEAPKTEESPKEEPKSEVKPTDDTL PKVEEGKEDSAEPAPVEE  
 VGGEVESKPEEKVAVKPESQPSDKPAEESKVEQAGEPVAPREDEKAPVEPEKQPEAPEEEKAVEETPKQ  
 EESTPDTKAEETVEPKEETVNQSI EQPKVETPAVEKQTEPTEEPKVEQAGEPVAPREDEQAPTAPVEPE  
 KQPEVP EEEKAVEETPKPEDKIKIGIGTKPEVDKSELNNQIDKASSVSPTDY

**SP056 nucleotide (SEQ ID NO:91)**

GGATGCTCAAGAACTGCGGGAGTTCACTATAAATATGTGGCAGATTTCAGAGCTATCATCAGAAGAAAA  
 GAAGCAGCTTGTCTATGATATTCGACATACGTGGAGAATGATGAGAACTATTATCTTGTATTATAA  
 GTTAAATTC TCAAAATCAACTGGCGGAATTGCCAAATACTGGAAGCAAGAATGAGAGGCAA

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**SP056 amino acid (SEQ ID NO:92)**

DAQETAGVHYKYVADSELSSZEKKQLVYDIPTYVENDDETYLVYKLN SQNLAE LPNTGSKNERQ

**SP057 nucleotide (SEQ ID NO:93)**

CGACAAAGGTGAGACTGAGGTTCAACCAGAGTCGCCAGATACTGTGGTAAGTGATAAAGGTGAACCAGA  
GCAGGTAGCACCGCTTCCAGAAATATAAGGGTAATATTGAGCAAGTAAACCTGAAACTCCGGTTGAGAA  
GACCAAAGAACAAGGTCCAGAAAAAAGTGAAGAAGTTCAGTAAACCAACAGAGAAACACCGAGTAA  
TCCAAATGAAGGTACTACAGAAGGAACCTCAATTCAAGAAGCAGAAAAATCCAGTTCAACCTGCAGAAGA  
ATCAACAACGAATTACAGAGAAAGTATCACCAGATACATCTAGCAAAAATACTGGGGAAGTGTCAGTAA  
TCCTAGTGATTGACAACTCAGTTGGAGAATCAAAATAAACAGAACATAATGACTCTAAAAATGAAAA  
TTCAGAAAAAAGTGTAGAAGAAGTTCAGTAAATCCAAATGAAGGCACAGTAGAAGGTACCTCAAATCA  
AGAAACAGAAAAACAGTTCAACCTGCAGAAGAAACACAAACAACTCTGGGAAAAATAGCTAACGAAAA  
TACTGGAGAAGTATCCAATAAACCTAGTGATTCAAACCAACAGTTGAAGAATCAAAATCAACCCAGAAAA  
AAACGGAAGTGCACAAAACAGAAAAATTCAGGTAATACAACATCAGAGAATGGACAAACAGAACCCAGA  
ACCATCAAACGGAAATTCAACTGAGGATGTTTCAACCGAATCAAAACATCCAATTCAAATGGAAACGA  
AGAAATTAAACAAGAAAAATGAAGTAGACCTGTAAAAAGGTAGAAGAACCAGAGAAAAACACTTGAATT  
AAGAAAT

**SP057 amino acid (SEQ ID NO:94)**

DKGETEVQPESPTVVS DKGEPEQVAPLPEYKGNIEQVKPETPVEKTKEQGPEKTEEV PVKPT EETPVN  
PNEGTT EGTSIQEAENPVQPAEESTTNSEKVSPTSSKNTGEVSSNPSTSTSVGESNKP EHNDSKNEN  
SEKTVEEVPVNPNEGTVEGTSNQETEKPVQPAEETQTNNGKIANENTGEVSNKP?SDSKPPVEESNQPEK  
NGTATKPENSGNTTSENGQTEPEPSNGNSTEDVSTESNTSNSNGNEEIKQENELDPDKKVEEPEKTLEL  
RN

**SP058 nucleotide (SEQ ID NO:95)**

AAATCAATTGGTAGCACAGATCCAAAAGCACAAGATAGCACTAACTGACTGCTGAAAAATCAACTGT  
TAAAGCACCTGCTCAAAGAGTAGATGTAAAAGATATAACTCATTTAACAGATGAAGAAAAAGTTAAGGT  
TGCTATTTTACAAGCAAATGGTTTCAGCATTAGACGGAGCGACAATCAATGTAGCTGGAGATGGTACAGC  
AACAATCACATTTCCAGATGGTTTCAGTAGTGACGATTCTAGGAAAAGATACAGTTCAACAATCTGCGAA  
AGGTGAATCTGTAACTCAAGAAGCTACACCAGAGTATAAGCTAGAAAAATACACCAGGTGGAGATAAGGG  
AGGCAATACTGGAAGCTCAGATGCTAATGCGAATGAAGGCGGTGGTAGCCAGGCGGGTGGATCAGCTCA  
CACAGGTTACAAAACTCAGCTCAATCACAAGCTTCTAAGCAATTAGCTACTGAAAAAGAATCAGCTAA  
AAATGCCATTGAAAAAGCAGCCAAAGGACAAGCAGGATGAAATCAAAGGCGCACCGCTTTCTGTATAAAGA  
AAAAGCAGAACTTTTAGCAAGAGTGAAGCAGAAAAACAAGCAGCTCTCAAAGAGATTGAAAAATGCGAA  
AACTATGGAAGATCTGAAGGAAGCAGAAACGATTGGAGTGCAAGCCATTGCCATGGTTACAGTTCCTAA  
GAGACCAGTGGCTCCTAAT

**SP058 amino acid (SEQ ID NO:96)**

NQLVAQDPKAQDSTKLTA EKSTVKAPQRVDVKDI THLTDEEKVKVAILQANGSALDGATINVAGDGTA  
TITFPDGSVVITILGKDTVQSSAKGESVTQEATPEYKLENTPGDGKGGNTGSSDANANEGGGSQAGGSAH  
TGSQNSAQSQASKQLATEKESAKNAIEKAARDKQDEIKGAPLSDKEAELLARVEAEKQAALKEIENAK  
TMEDVKEAETIGVQAIAMVTVKRPVAPN

**SP059 nucleotide (SEQ ID NO:97)**

CAAACAGTCAGCTTCAGGAACGATTGAGGTGATTTACAGAGAAAAATGGCTCTGGGACACGGGGTGCCTT  
CACAGAAATCACAGGGATTCTCAAAAAAGACGGTGATAAAAAAATTGACAACACTGCCAAAACAGCTGT  
GATTCAAAAATAGTACAGAAGGTGTTCTCTCAGCAGTTCAAGGGAATGCTAATGCTATCGGCTACATCTC  
CTTGGGATCTTTAACGAAATCTGTCAAGGCTTTAGAGATTGATGGTGCAAGGCTAGTCGAGACACAGT  
TTTAGATGGTGAATACCTCTTCAACGTCCCTTCAACATTGTTTGGTCTTCTAATCTTTCCAAGCTAGG  
TCAAGATTTTATCAGCTTTTCACTCCAAACAAGGTCAACAAGTGGTTCACAGATAATAAATTTATTGA  
AGCTAAAAACCGAAACCGGAATATACAAGCCAACACTTATCAGGCAAGTTGTCTGTTGTAGGTTCCAC  
TTCAGTATCTTCTTAATGGAAAAATTAGCAGAAGCTTATAAAAAAGAAAAATCCAGAAGTTACGATTGA  
TATTACCTCTAATGGGTCTTCAGCAGGTATTACCGCTGTTAAGGAGAAAAACCGCTGATATTGGTATGGT  
TTCAGGGAAATTAATCCTGAAGAAGGTAAAGAGTCTACCCATGATGCTATTGCTTTAGACGGTATTGC  
TGTTGTGGTCAATAATGACAATAAGGCAAGCCAAGTCAGTATGGCTGAACCTGCAGACGTTTTTAGTGG  
CAAATTAACCACTGGGACAAGATTAAA

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**SP059 amino acid (SEQ ID NO:98)**

KQSASGTIEVISRENGSGTRGAFTEITGILKKDGDKKIDNTAKTAVIQNSTEGVLSAVQGNANAIGYIS  
LGS�TKSVKALEIDGVKASRDVLDGEYPLQRPFNIVWSSNLSKLGQDFISFIHSKQCGQVVDNKFIE  
AKTETTEYTSQHLSGKLSVVGSTSVSSLMKLAELAEYKKENPEVTIDITSNGSSAGITAVKEKTADIGMV  
SRELTPEEGKSLTHDAIALDGIADVNNNDNKASQVSMELADVFSGLKLTWDKIK

**SP060 nucleotide (SEQ ID NO:99)**

ATTCCGATGATGCGGATGAAAAGATGACCCGTGATGAAATTGCCTATATGCTGACAAATAGTGAAGAAAC  
ATTGGATGCTGATGAGATTGAGATGCTACAAGGTGCTTTTCGCTCGATGAACTGATGGCAGCAGAGGT  
TATGGTTCCTCGAACGGATGCCTTTATGGTGGATATTCAGGATGATAGTCAAGCCATTATCCAAAGTAT  
TTTAAACAAAAATTATTCCTGATCCCGGTTTATGATGGGGATAAGGACAATGTAATTGGAATCATTCA  
CACCAAGAGTCTCCTTAAGGCAGGCTTTGTGGACGGTTTGTGACAAATATTGTTTGAAGAGAAATTTACA  
AGATCCACTTTTGTACCTGAACTATTTTGTGGATGACTTGCTAAAAGAACTGCGAAATACCCAAAG  
ACAAATG

**SP060 amino acid (SEQ ID NO:100)**

FDDADEKMTRDEIAYMLTNSEETLDADEIEMLOGVFSLELMAREVMVPRDADFMDIQDDSOAIIQSI  
LKQNSRIPIVYDGDKNVIGIHTKSLKAGFVDGFDNIVWKRIQLDPLFVPETIFVDDLLKELRNTQR  
QM

**SP062 nucleotide (SEQ ID NO:101)**

GGAGAGTCGATCAAAAGTAGATGAAGCTGTGTCTAAGTTTGAAAAGGACTCATCTTCTTCGTCAAGTTC  
AGACTCTTCCACTAAACCGGAAGCTTCAGATACAGCGAAGCCAAACAAGCCGACAGAACCAGGAGAAAA  
GGTAGCAGAAGCTAAGAAGAAGGTTGAAGAAGCTGAGAAAAAGCCAGGATCAAAAAGAAGAAGATCG  
TCGTAACACCCAAACCTTACTTACAAAACGCTTGAAGTTGAAATTGCTGAGTCCGATGTGGAAGTTAA  
AAAAGCGGAGCTTGAAGTAGTAAAGTGAAGCTAACGAACCTCGAGACGAGCAA

**SP062 amino acid (SEQ ID NO:102)**

ESRSKVDEAVSKFEKSSSSSSSDSSTKPEASDTAKPNKPTEPGEKVAEAKKKVEEAEEKAKKDQKEEDR  
RNYPTITTKTLELEIAESDVEVKAELELVKVKANEPRDEQ

**SP063 nucleotide (SEQ ID NO:103)**

ATGGACAACAGGAAACTGGGACGAGGTTATATCTGGTAAGATTGACAAGTACAAAGATCCAGATATTCC  
AACAGTTGAATCACAAGAAGTTACGTGAGACTCTAGTGATAAAGAAATAACGGTAAGGTATGACCGTTT  
ATCAACACCAGAAAAACCAATCCCAACCAAAATCCAGAGCATCCAAGTGTTCGACACCAAAACCCAGA  
ACTACCAAAATCAAGAGACTCCAACACCAGATAAACCAACTCCAGAACCAGGTACTCCAAAACTGAAAC  
TCCAGTGAATCCAGACCCAGAAGTTCGACTTATGAGACAGGTAAGAGAGAGGAATTGCCAACACAGG  
TACAGAAGCTAAT

**SP063 amino acid (SEQ ID NO:104)**

WTTGNWDEVISGKIDKYKDPDIPTVESQEVTSDDSDKEITVRYDRLSTPEKPIQPQNPHEPSVPTPNPE  
LPNQETPTPDKPTPEPGTPTETPVNPDPEVPTYETGKREELPNTGTEAN

**SP064 nucleotide (SEQ ID NO:105)**

CGATGGGCTCAATCCAACCCAGGTCAAGTCTTACCTGAAGAGACATCGGGAACGAAAGAGGGTGACTT  
ATCAGAAAAACAGGAGACACCGTTCTCACTCAAGCGAAACCTGAGGGCGTTACTGGAAATACGAATTC  
ACTTCCGACACCTACAGAAAGAACTGAAGTGAGCGAGGAAACAAGCCCTTCTAGTCTGGATACACTTTT  
TGAAAAAGATGAAGAAGCTCAAAAAATCCAGAGCTAACAGATGTCTTAAAGAACTGTAGATACAGC  
TGATGTGGATGGGACACAAGCAAGTCCAGCAGAACTACTCCTGAACAAGTAAAAGGTGGAGTGAAAGA  
AAATACAAAAGACAGCATCGATGTTCTGCTGCTTATCTTGAAAAAGCTGAAGGGAAAGGTCCTTTTAC  
TGCCCGGTGTAAACCAAGTAATTCCTTATGAAGTATTCGCTGGTGGTATGTTAACTCGTCTATTACT  
AAAAGCTTCGGATAATGCTCCTGGTCTGACAATGGTACTGCTAAAAATCCTGCTTACCTCCTCTTGA  
AGGATTAACAAAAGGGAAATACTTCTATGAAGTAGACTTAAATGGCAATACTGTTGGTAAACAAGGTCA  
AGCTTTAATTGATCAACTTCGCGCTAATGGTACTCAAACCTTATAAAGCTACTGTTAAAGTTTACGGAAA  
TAAAGACGGTAAAGCTGACTTGACTAATCTAGTTGCTACTAAAAATGTAGACATCAACATCAATGGATT  
AGTTGCTAAAGAAACAGTTCAAAAAGCGTTGCAGACAACGTTAAAGACAGTATCGATGTTCCAGCAGC  
CTACCTAGAAAAAGCCAAAGGTGAAGGTCCATTACAGCAGGTGTCAACCATGTGATTCCATACGAAC  
CTTCGACGGTATGGCATGTTGACTCGTCTCTTGCTCAAGGCATCTGACAAGGCACCATGGTCAGATAA



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CGGCGACGCTAAAAACCCAGCCCTATCTCCACTAGGCGAAAAACGTGAAGACCAAGGTCAATACTTCTA  
TCAANTAGCCTTGGACGGAATGTAGCTGGCAAAGAAAAACAAGCGCTCATTGACCAGTTCCGAGCAAA  
NGGTACTCAAACCTTACAGCGCTACAGTCAATGTCTATGGTAACAAAGACGGTAAACCAGACTTGGACAA  
CATCGTAGCAACTAAAAAGTCACTATTAACATAAACGGTTTAAATTTCTAAAGAAACAGTTCAAAAAGC  
CGTTGCAGACAACGTTAANGACAGTATCGATGTTCCAGCAGCCTACCTAGAAAAAGCCAAGGGTGAAGG  
TCCATTACAGCAGGTGTCAACCATGTGATTCCATACGAACTCTTCGCAGGTGATGGTATGTTGACTCG  
TCTCTTGCTCAAGGCATCTGACAAGGCACCATGGTCAGATAACGGNGACGCTAAAAACCCAGCNCATC  
TCCACTAGGTGAAAACGTGAAGACCAAGGTCAATACTTCTATCAANTAGCCTTGGACGGAATGTAGC  
TGGCAAAGAAAAACAAGCGCTCATTGACCAGTTCCGAGCAAACGGTACTCAAACCTACAGCGCTACAGT  
CAATGTCTATGGTAACAAAGACGGTAAACCAGACTTGGACAACATCGTAGCAACTAAAAAGTCACTAT  
TAAGATAAATGTTAAAGAAACATCAGACACAGCAAATGGTTCATTATCACCTTCTAACTCTGGTTCTGG  
CGTGACTCCGATGAATCACAATCATGTACAGGTACTACAGATAGCATGCCTGCTGACACCATGACAAG  
TTCTACCAACACGATGGCAGGTGAAAACATGGCTGCTTCTGCTAACAAGATGCTGATACGATGATGTC  
AGAGGATAAAGCTATG

**SP064 amino acid (SEQ ID NO:106)**

DGLNPTPGQVLPETSGTKEGDLSEKPGDVLTOAKPEGVTGNTNSLPTPTERTVSEETSPSSLDTLF  
EKDEEAQKNPELTDVLKETVDTADVDGTQASPAETTPEQVKGGVKENTKDSIDVPAAYLEKAEKGPF  
AGVNVQVLPYELFAGDGMLTRLLKASDNAFWSDNGTAKNPALPPLLEGLTKGYFYEVLDLNGNTVKGQGO  
ALIDQLRANGTQTYKATVKVYGNKDGKADLTNLVATKNVDININGLVAKETVQKAVADNVKDSIDVPA  
YLEKAKGEGPFTAGVNHVLPYELFAGDGMLTRLLKASDKAPWSNDGDAKNPALSPLGENVTKGQYFY  
QXALDGNVAGKEKQALIDQFRAXGTQYTSATVNVYGNKDGKPDLDNIVATKKVTININGLISKETVQKA  
VADNVKDSIDVPAAYLEKAKGEGPFTAGVNHVLPYELFAGDGMLTRLLKASDKAPWSNDGDAKNPALS  
PLGENVTKGQYFYQXALDGNVAGKEKQALIDQFRANGTQYTSATVNVYGNKDGKPDLDNIVATKKVTI  
KINVKETS DTANGSLSPSNSGSGVT PMNHNHATGTTDSMPADTMTSSTNTMAGENMAASANKMSDTMMS  
EDKAM

**SP065 nucleotide (SEQ ID NO:107)**

TTCCAATCAAAACAGGCAGATGGTAACTCAATATCGTGACAACCTTTTACCCTGTCTATGAATTAC  
CAAGCAAGTCGCGAGGAGATACGGCTAATGTAGAATCCTAATCGGTGCTGGGACAGAACCTCATGAATA  
CGAACCATCTGCCAAGGCAGTTGCCAAAAATCCAAGATGCAGATACCTTCGTTTATGAAAATGAAAACAT  
GGAAACATGGGTACCTAAATTGCTAGATACCTTGGATAAGAAAAAAGTGAAAACCATCAAGGCGACAGG  
CGATATGTTGCTCTTGCCAGGTGGCGAGGAAGAAGAGGGAGACCATGACCATGGAGAAGAAGGTCATCA  
CCATGAGTTTGACCCCCATGTTTGGTTATCACCAGTTCGTGCCATCAAACTAGTAGAGCACCATCCGCG  
ACACTTGTACAGCAGATTATCCTGATAAAAAGAGACCTTTGAGAAGAATGCAGCTGCCTATATCGAAAA  
ATTGCAAGCCTTGGATAAGGCTTACGCAGAAGGTTTGTCTCAAGCAAAACAAAAGAGCTTTGTGACTCA  
ACACGCAGCCTTTAACTATCTTGCCCTGGACTATGGGACTC

**SP065 amino acid (SEQ ID NO:108)**

SNQKQADGKLNIVTTFYPVYEFTKQVAGDTANVELLIGAGTEPHEYEPSAKAVAKIQDADTFVYENENM  
ETWVPKLLDLDLKKVKTIKATGDMLLLPGGEEEEGDHGHGEEGHHHEFDPHVWLSVPVRAIKLVEHHP  
HLSADYPDKKETFEKNAAYIEKLQALDKAYAEGLSQAKQKSFVTQHAFFNYLALDYGT

**SP067 nucleotide (SEQ ID NO:109)**

TATCACAGGATCGAACGGTAAGACAACCACAACGACTATGATTGGGGAAGTTTGTGCTGCTGGCCA  
ACATGGTCTTTTATCAGGGAATATCGGCTATCCAGCTAGTCAGGTTGCTCAAATAGCATCAGATAAGGA  
CACGCTTGTTATGGAACCTTCTTCTTTCCAACCTCATGGGTGTTCAAGAATCCATCCAGAGATTGCGGT  
TATTACCAACCTCATGCCAACTCATATCGACTACCATGGGTCAATTTTCGGAATATGTAGCAGCCAAGTG  
GAATATCCAGAACAGATGACAGCAGCTGATTTCTTGTCTTGAACCTTAATCAAGACTTGGCAAAAAGA  
CTTGACTTCCAAGACAGAAAGCCACTGTTGTACCATTTTCAACACTTGAAAAGGTTGATGGAGCTTATCT  
GGAAGATGGTCAACTCTACTTCCGTGGTGAAGTAGTCATGGCAGCGAATGAAATCGGTGTTCCAGGTAG  
CCACAATGTGGAATAATGCCCTTGGGACTATTGCTGTAGCCAAGCTTCGTGATGTGGACAATCAAACCAT  
CAAGGAACTCTTTCAGCCTTCGGTGGTGTCAAACACCGTCTCCAGTTTGTGGATGACATCAAGGGTGT  
TAAATCTATAACGACAGTAAATCAACTAATATCTTGGCTACTCAAAAAGCCTTGTGAGATTGACAA  
CAGCAAGGTCGCTTGTGATTGCAGGTGGTTTGGACCGTGGCAATGAGTTTGACGAATTGGTGCCAGACAT  
TACTGGACTCAAGAAGATGGTCATCTGGGTCAATCTGCAGAACGTGTCAAACGGGCAGCAGACAAGGC  
TGGTGTGCTTATGTGGAGGCGACAGATATTGCAGATGCGACCCGCAAGGCCTATGAGCTTGGGACTCA

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AGGAGATGTGGTTCTTCTTAGTCTGCCAATGCTAGCTGGGATATGTATGCTAACTTTGAAGTACGTGG  
CGACCTCTTTATCGACACAGTAGCGGAGTTAAAAGAA

**SP067 amino acid (SEQ ID NO:110)**

GITGSNGKTTTTMTIGEVLTAAQGHLLSGNIGYPASQVAQIASDKDTLVMELSSFQLMGVQEFHPEIA  
VITNLMPTHIDYHGSFSEYVAAKWNINQKMTAADFLVLNFNQDLAKDLTSKTEATVVPFSTLEKVDGAY  
LEDGQLYFRGEVMAANEIGVPGSHNVENALATIAVAKLRDQVNDQTIKETLSAFGGVKHRLQFVDDIKG  
VKFYNDKSTNIIATQKALSGFDNSKVLIAGGLDRGNEFDELVPDITGLKKMVLGQSAERVKRAADK  
AGVAYVEATDIADATRKAYELATQGDVVLSPANASWDMYANFEVRGDLFIDTVaelke

**SP068 nucleotide (SEQ ID NO:111)**

AAGTTCATCGAAGATGGTTGGGAAGTCCACTATATCGGGGACAAGTGTGGTATCGAACACCAAGAAATC  
CTTAAGTCAGGTTTGGATGTCACCTTCCATTCTATTGCGACTGGAAAATTGCGTCGCTATTTCTCTTGG  
CAAAATATGCTGGACGCTCTCAAAGTTGGTTGGGGAATTGTCCAATCGCTCTTTATCATGTTGCGACTG  
CGTCCACAGACCCCTTTTTCAAAGGGGGGCTTTGTCTCAGTACCGCCTGTTATCGCTGCGCGTGTGTCA  
GGAGTGCCCTGCTTTATTACGAATCTGACCTGTCTATGGGCTTGGCCAATAAAATCGCTTATAAATTT  
CGGACTAAGATGTATTCAACCTTTGAACAAGCTTCGAGTTTGGCTAAGGTTGAGCATGTGGGAGCGG

**SP068 amino acid (SEQ ID NO:112)**

SSSKMVGKSTISGTSVVSNTKKSLSQVWMSPSILLRLENCVAISLGKICWTSSKLVGELSNRSLSCDC  
VHRPFQRGALSQYRLLSLRVCQECLSLFTNLTLCLWAWPIKSPINLRLRCIQPLNKLRLVWLRSLMWER

**SP069 nucleotide (SEQ ID NO:113)**

ATCGCTAGCTAGTGAAATGCAAGAAAGTACACGTAAATTCAGGTTACTGCTGACCTAACAGATGCCGG  
TGTGGGAACGATTGAAGTTCTTTGAGCATTGAAGATTTACCCAATGGGCTGACCGCTGTGGCGACTCC  
GCAAAAAATTACAGTCAAGATTGGTAAGAAGGCTCAGAAGGATAAGGTAAAGATTGTACCAGAGATTGA  
CCCTAGTCAAATTGATAGTCGGGTACAAATGAAAATGTCATGGTGTGAGATAAAGAAGTGTCTATTAC  
GAGTGACCAAGAGACATTGGATAGAATTGATAAGATTATCGCTGTTTTGCCAACTAGCGAACGTATAAC  
AGGTAATTACAGTGGTTCAGTACCTTTGCAGGCAATCGACCGCAATGGTGTTGTCTTACCGGCAGTTAT  
CACTCCGTTTGATACAATAATGAAGGTGACTACAAAACAGTAGCACCAAGTTCAAGCACATCAAATTC  
AAGTACAAGCAGTTTCATCGGAGACATCTTCGTCAACGAAAGCAACTAGTTCAAAAACGAAT

**SP069 amino acid (SEQ ID NO:114)**

SLASEMQESTRKFKVTADLTDAVGVTIEVPLSIEDLPNGLTAVATPQKITVKIGKKAQKDKVKIVPEID  
PSQIDSRVQIENVMVSDKEVSITSDQETLDRIDKIIAVLPTSERITGNYSVPLQAIIDRNGVVLPAVI  
TPFDTIMKVTTKPVAPSSSTSNSSSTSSSSTSSSKTN

**SP070 nucleotide (SEQ ID NO:115)**

GCACCAGATGGGGCACAAGGTTTCAGGGATCAGATGTTGAAAAGTACTACTTTACCCAACGCGGTCTTGA  
GCAGGCAGGAATTACCATTTCTCTTTTGATGAAAAAATCTAGACGGTGATATGGAAATTATCGCTGG  
AAATGCCCTTTCTGTCAGATAACAACGTCGAAATTCGCTATGCGGACCAAAATGGTATCAGCTACAAACG  
TTACCATGAGTTTCTAGGTAGCTTTATGCGTGACTTTGTTAGCATGGGAGTAGCAGGAGCACATGGAAA  
AACTTCAACGACAGGTATGTTGTCTCATGTCTTGTCTCACATTACAGATACCAGCTTCTTGATTGGAGA  
TGGGACAGGTCTGGTTCGGCCAATGCCAAATATTTGTCTTTGAATCTGACGAATATGAGCGTCACTT  
CATGCCTTACCACCAGAACTACTCTATTATACCAACATTGACTTTGACCATCCAGATTATTTACAAG  
TCTCGAGGATGTTTTAATGCCCTTTAACGACTATGCCAAACAAATCACCAGGGTCTTTTTGTCTATGG  
TGAAGATGCTGAATTGCGTAAGATTACGCTGATGCACCAATTTATTATATGGTTTTGAAGCTGAAGG  
CAATGACTTTGTAGCTAGTGATCTTCTTCGTTCAATAACTGGTTCAACCTTCACCGTTCAATTTCCGTTGG  
ACAAAACCTTGGGGCAATTCCACATTCCAACCTTTGGTCGTCACAATATCATGAATGCGACAGCCGTTAT  
TGGTCTTCTTTACACAGCAGGATTTGATTTGAACTTGGTGCGTGAGCACTTGAAAACATTTGCCGGTGT  
TAAACGTCGTTTCACTGAGAAAATTGTCAATGATACAGTGATTATCGATGACTTTGCCCACCATCCAAC  
AGAAATTAATTGCGACCTTGGATGCGGCTCGTCAGAAATACCCAAGCAAGGAAATTTAGCAGCTCTTCA  
ACCGCATACCTTTACAAGAACCATTGCCTTGGTTGGACGACTTTGCCCATGCTTTAAACCAAGCAGATGC  
TGTTTATCTAGCGCAAAATTTATGGCTCGGCTCGTGAAGTAGATCATGGTGACGTTAAGGTAGAAGACCT  
AGCCAAACAAAATCAACAAAAACACCAAGTGATTACTGTTGAAAATGTTTCTCCACTCCTAGACCATGA  
CAATGCTGTTTACGTCTTTATGGGAGCAGGAGACATCCAAACCTATGAATACTCATTTGAGCGTCTCTT  
GTCTAAGTTGACAAGCAATGTTCAA

Table 1

## SP070 amino acid (SEQ ID NO:116)

HQMGHKVQGS DVEKYFTQ RGLEQAGITILPFDEKNLDGDM EIIAGNAFRPDNNVEIAYADQNGISYKR  
YHEFLGSFMRDFVSMGVAGAHGKTSTTGMLSHVLSHITDTSFLIGDGTGRGSANAKYFVFESDEYERHF  
MPYHP EYSIITNIDFDHPDYFTSLEDVFNAFNDYAKQITKGLFVYGEDAELRKITS DAPIYVYGF EAE G  
NDFVASDLLRSITGSTFTVHFRGQNLGQFHIPTFGRHNIMNATAVIGLLYTAGFDLNLVREHLKTFAGV  
KRRFTEKIVNDTVIIDFAHHPTEIIATLDAARQKYP SKEIVAVFQPHTFTRTIALLD DFAHALNQADA  
VYLAQIYGSAREVDHGDVKVEDLANKINKKHQVITVENVSPLLDH DNAVYVFMGAGDIQTYEYSFERLL  
SNLTSNVQ

## SP071 nucleotide (SEQ ID NO:117)

TTTTAACCCAACTGTTGGTACTTTCTTTTACTG CAGGATTGAGCTTGTAGTTTATTGGTTTCTAA  
AAGGGAAAAATGGAAGAAACGACTTGTTCATTTCTGCTGTTGACTAGCATGGGAGTTCAATTGTTGCC  
GGCCAGTGCCTTTGGGTTGACCAGCCAGATTTTATCTGCCTATAATAGTCAGCTTTCTATCGGAGTCGG  
GGAACATTTACCAGAGCCTCTGAAAATCGAAGGTTATCAATATATTGGTTATATCAAAAACCTAAGAAACA  
GGATAATACAGAGCTTTCAAGGACAGTTGATGGGAAATACTCTGCTCAAAGAGATAGTCAACCAAACCTC  
TACAAAAACATCAGATGTAGTTCATTCAGCTGATTTAGAATGGAACCAAGGACAGGGGAAGGTTAGTTT  
ACAAGGTGAAGCATCAGGGGATGATGGACTTTAGAAAATCTTCTATAGCAGCAGACAATCTATCTTC  
TAATGATTTCATTCGCAAGTCAAGTTGAGCAGAAATCCGGATCACAAAGGAGAACTCTGTAGTTTCGACCAAC  
AGTGCCAGAACAAAGGAAATCCTGTGTCTGCTACAACGGTG CAGAGTGCGGAAGAGGAAGTATTGGCGAC  
GACAAATGATCGACAGAGTATAAACTTCCATTGGAACCAAGGCACGCAAGAACCCGGTCATGAGGG  
TGAAGCCCGCAGTCCGTTGAAGACTTACCAGTCTACACTAAGCCACTAGAAACCAAGGTACACAAGGACC  
CGGACATGAAGGTGAAGCTGCAGTTCGCGAGGAAGAACCAGCTTACACAGAACCCTTAGCAACGAAAGG  
CACGCAAGAGCCAGGTCATGAGGGCAAAGCTACAGTCCGCGAAGAGACTCTAGAGTACACGGAAACCGGT  
AGCGCAAAAAGGCACACAAGAACCCGAACATGAGGGCGAaCGG=CAGTAGAAGAAGAACTTCCGGCTTT  
AGAGGTCACTACACGAAATAGAACGGAATCCAGAATATTCTTTATACAACAGAAGAAATTCAGGATCC  
AACACTTCTGAAAAATCGTCGTAAGATTGAACGACAAGGCAAGCAGGGACAGTACAATTCAATATGA  
AGACTACATCGTAAATGGTAATGTCGTAGAACTAAAGAAGTGTACGAACTGAAGTAGCTCCGGTCAA  
CGAAGTCGTTAAAGTAGGAACACTTGTGAAAGTTAAACCTACAGTAGAAATTACAACTTAACAAAAGT  
TGAGAACAAAAATCTATAACTGTAAGTTATAACTTAATAGACACTACCTCAGCATATGTTTCTGCAAA  
AACGCAAGTTTTCCATGGAGACAAGCTAGTTAAAGAGGTGGATATAGAAAACTCTGCCAAAGAGCAAGT  
AATATCAGGTTTAGATTACTACACCCGTATACAGTTAAACACACCTAACTTATAATTGGGTGAAAA  
TAATGAGGAAAAATACTGAAACATCAACTCAAGATTCCAAATTAGAGTATAAGAAAAATAGAGATTAAAGA  
TATTGATTCAGTAGAATTATACGGTAAAGAAATGATCGTTATCGTAGATATTTAAGTCTAAGTGAAGC  
GCCGACTGATACGGCTAAATACTTTGTAAAAGTGAAATCAGATCGCTTCAAAGAAATGTACCTACCTGT  
AAAATCTATTACAGAAAAATACGGATGGAACGTATAAAGTGACGGTAGCCGTTGATCAACTTGTGCAAGA  
AGGTACAGACGGTTACAAAGATGATTACACATTTACTGTAGCTAAATCTAAAGCAGAGCAACCAGAGT  
TTACACATCCTTTAAACAGCTGGTAACAGCCATGCAAGCAATCTGTCTGGTGTCTATACATTTGGCTTC  
AGATATGACCGCAGATGAGGTGAGCTTAGGCGATAAGCAGACAAGTTATCTCACAGGTGCATTTACAGG  
GAGCTTGATCGGTTCTGATGGAACAAAATCGTATGCCATTTATGATTTGAAGAAACCATTTATTGATAC  
ATTAATGGTGCTACAGTTAGAGATTTGGATATTTAAACTGTTTCTGCTGATAGTAAAGAAAAATGTCGC  
AGCGCTGGCGAAGGCAGCGAATAGCGCGAATATTAATAATGTTGCAGTAGAAGGAAAAATCTCAGGTGC  
GAAATCTGTTGCGGGATTAGTAGCGAGCGCAACAAATACAGTGATAGAAAACAGCTCGTTTACAGGGAA  
ACTTATCGCAAAATCACCAGGACAGTAATAAAAAATGATACTGGAGGAATAGTAGGTAATATAACAGGAAA  
TAGTTCCAGAGAGTTAATAAAGTTAGGGTAGATGCCTTAATCTCTACTAATGCACGCAATAATAACCAAAC  
AGCTGGAGGGATAGTAGGTAGATTAGAAAAATGGTGCATTGATATCTAATTCGGTTGCTACTGGAGAAAT  
ACGAAATGGTCAAGGATATCTAGAGTCGGAGGAATAGTAGGATCTACGTGGCAAAACGGTCGAGTAAA  
TAATGTTGTGAGTAACGTAGATGTTGGAGATGGTTATGTTATCACCGGTGATCAATACGCAGCAGCAGA  
TGTGAAAAATGCAAGTACATCAGTTGATAATAGAAAAGCAGACAGATTCGCTACAAAATTTATCAAAAGA  
CCAAATAGACGCGAAAGTTGCTGATTATGGAATCACAGTAACTCTTGATGATCTGGGCAAGATTAAA  
ACGTAATCTAAGAGAAAGTTGATTATACAAGACTAAATAAAGCAGAAGCTGAAAGAAAAGTAGCTTATAG  
CAACATAGAAAACTGATGCCATTTCTACAATAAAGACCTAGTAGTTCATGTTAACAAGTAGCGAC  
AACAGATAAACTTTACACTACAGAAATGTTAGATGTTGTGCGGATGAAAGATGATGAAGTAGTAACGGA  
TATTAATAATAAGAAAAATTCATAAATAAAGTTATGTTACATTTCAAAGATAATACAGTAGAATACCT  
AGATGTAACATTCAAAGAAAACCTTCAATAACAGTCAAGTAATCGAATACAATGTTACAGGAAAAAGATA  
TATATTCACACCAGAAGCATTTGTTTCAGACTATACAGCGATAACGAATAACGTACTAAGCGACTTGCA  
AAATGTAACACTTAAC

## SP071 amino acid (SEQ ID NO:118)

Table 1

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FNPTVGTFLLFTAGLSLLVLLVSKRENGKKRLVHFLLLTSMGVQLLPASAFGLTSQILSAYNSQLSIGVG  
EHLPEPLKIEGYQYIGYIKTKQDNTELSRTVDGKYSQQRDSQPNSTKTSDDVHSADLEWNQGGKVS  
QGEASGDDGLSEKSSIAADNLSSNDSFASQVEQNPDKHGESVVRPTVPEQGNPVSATTQVSAEEVLAT  
TNDRPEYKLPLETGKTQEPGHEGEAAVREDLPVYTKPLETKGTQGPGEHEGEAAVREEEPAYTEPLATKG  
TQEPGHEGKATVREETLEYTEPVATKGTQEPHEGERXVEELPALEVTTNRNTEIQNIPYTTEEIQDP  
TLLKNRRKIERQAGTRTIQYEDYIVNGNVVETKEVSRTEVAPVNEVVKVGLTVKVKPTVEITNLTKV  
ENKKSITVSYNLIDTTSAYVSAKTQVFHGDKLVEVDIENPAKEQVISGLDYTPYTVKTHLTYNLNGEN  
NEENTETSTQDFQLEYKKIEIKDIDSVELYGKENDRYRRYLSLSEAPDTAKYFVKVKSDFKEMLPV  
KSITENTDGTYKVTVAVDQLVEEGTDGYKDDYFTVAKSKAEQPGVYTSFKQLVTAMQSNLSGVYTLAS  
DMTAEVSLGDKQTSYLTGAFTGSLIGSDGKSYAIYDLKKPLFDTLNGATVRDLDIKTVSADSKENVA  
ALAKAANSANINNVAVEGKISGAKSVAGLVSATNTVIENSFTGKLIANHQDSNKNDTGGIVGNITGN  
SSRVNKVRVDALISTNARNNNQTAGGIVGRLENGALISNSVATGEIRNGQGYSRVGGIVGSTWQNGRVN  
NVVSNVDVGDGYVITGDQYAAADVKNASTSVDNRKADRFAKLSKDQIDAKVADYGITVTLLDDTGQDLK  
RNLREVDYTRLNKAERKVAYSNIEKLMFPYKDLVVHYGNKVATTDKLYTTELLDVVPMKDDEVVTD  
INNKKNSINKVMLHFKDNTVEYLDVTFKENFINSQVIEYNVTGKEYIFTPEAFVSDYTAITNNVLSDLQ  
NVTNLN

**SP072 nucleotide (SEQ ID NO:119)**

TTTAAACCCAACTGTTGGTACTTTCTCTTTTACTGCAGGATTGAGCTTGTTAGTTTTATTGGTTTCTAA  
AAGGGAAAAATGGAAGAAACGACTTGTTCATTTCTGCTGTTGACTAGCATGGGAGTTCAATTGTTGCC  
GGCCAGTGTCTTTTGGGTTGACCAGCCAGATTTTATCTGCCTATAATAGTCAGCTTTCTATCGGAGTCGG  
GGAACATTTACCAAGAGCCTCTGAAAAATCGAAGGTTATCAATATATTGGTTATATCAAACTAAGAAACA  
GGATAATACAGAGCTTTCAAGGACAGTTGATGGGAAATACTCTGCTCAAAGAGATAGTCAACCAAATC  
TACAAAAACATCAGATGTAGTTTCAATTCAGCTGATTAGAAATGGAACCAAGGACAGGGGAAGGTTAGTTT  
ACAAGGTGAAGCATCAGGGGATGATGGACTTTCAGAAAAATCTTCTATAGCAGCAGACAATCTATCTTC  
TAATGATTCATTCCGAAGTCAAGTTGAGCAGAAATCCGGATCACAAAGGAGAAATCTGTAGTTCCGACCAAC  
AGTGCCAGAAACAAAGGAAATCCTGTGTCTGTCTACAAACGGTGAGAGTGCAGGAAGAGGAAGTATTGGCGAC  
GACAAATGATCGACCAGAGTATAAACTTCCATTGGAAACCAAAGGCACGCAAGAACCCGGTCATGAGGG  
TGAAGCCGCGAGTCCGTGAAGACTTACCAGTCTACACTAAGCCACTAGAAACCAAAGGTACACAAGGACC  
CGGACATGAAGGTGAAGCTGCAGTTCCGCGAGGAAGAACCAGCTTACACAGAACCCTTAGCAACGAAAGG  
CACGCAAGAGCCAGGTCTAGAGGGCAAAGCTACAGTCCGCGAAGAGACTCTAGAGTACACGGAAACCGGT  
AGCGCAAAAAGGCACACAAGAACCAGCAATGAGGGCGAaCGGsCAGTAGAAGAAGAACTTCCGGCTTT  
AGAGGTCACTACACGAAATAGAACGGAATCCAGAATATTCCTTATACAACAGAAGAAATTCAGGATCC  
AACACTTCTGAAAAATCGTCGTAAGATTGAACGACAAGGGCAAGCAGGGACACGTACAATTCAATATGA  
AGACTACATCGTAAATGGTAATGTCTAGAACTAAAGAAGTGTACGAACTGAAGTACTCCGGTCAA  
CGAAGTCGTTAAAGTAGGAACACTTGTGAAAGTTAAACCTACAGTAGAAATTAACAACTTAACAAAAGT  
TGAGAACAAAAATCTATAACTGTAAGTTATAACTTAATAGACACTACCTCAGCATATGTTTTCGAAA  
AACGCAAGTTTTCATGGAGACAAGCTAGTTAAAGAGGTGGATATAGAAAACTCTGCCAAAAGAGCAAGT  
AATATCAGGTTTAGATTACTACACACCGTATACAGTTAAACACACCTAACTTATAATTTGGGTGAAAA  
TAATGAGGAAAATACTGAAACATCAACTCAAGATTTCCAATTAGAGTATAAGAAAATAGAGATTAAAGA  
TATTGATTCAGTAGAATTATACGGTAAAGAAAATGATCGTTATCGTAGA

**SP072 amino acid (SEQ ID NO:120)**

FNPTVGTFLLFTAGLSLLVLLVSKRENGKKRLVHFLLLTSMGVQLLPASAFGLTSQILSAYNSQLSIGVG  
EHLPEPLKIEGYQYIGYIKTKQDNTELSRTVDGKYSQQRDSQPNSTKTSDDVHSADLEWNQGGKVS  
QGEASGDDGLSEKSSIAADNLSSNDSFASQVEQNPDKHGESVVRPTVPEQGNPVSATTQVSAEEVLAT  
TNDRPEYKLPLETGKTQEPGHEGEAAVREDLPVYTKPLETKGTQGPGEHEGEAAVREEEPAYTEPLATKG  
TQEPGHEGKATVREETLEYTEPVATKGTQEPHEGERXVEELPALEVTTNRNTEIQNIPYTTEEIQDP  
TLLKNRRKIERQAGTRTIQYEDYIVNGNVVETKEVSRTEVAPVNEVVKVGLTVKVKPTVEITNLTKV  
ENKKSITVSYNLIDTTSAYVSAKTQVFHGDKLVEVDIENPAKEQVISGLDYTPYTVKTHLTYNLNGEN  
NEENTETSTQDFQLEYKKIEIKDIDSVELYGKENDRYRR

**SP073 nucleotide (SEQ ID NO:121)**

TCGTAGATATTTAAGTCTAAGTGAAGCGCGGACTGATACGGCTAAATACTTTGTAAAAGTGAAATCAGA  
TCGCTTCAAAGAAATGTACCTACCTGTAATACTATTACAGAAAAATACGGATGGAACGTATAAAGTGAC  
GGTAGCCGTTGATCAACTTGTCTGAAGAAGGTACAGACGGTTACAAAGATGATTACACATTTACTTAGC  
TAAATCTAAAGCAGAGCAACCAGGAGTTTACACATCCTTTAAACAGCTGGTAACAGCCATGCAAAGCAA  
TCTGTCTGGTGTCTATACATTGGCTTCAGATATGACCCGAGATGAGGTGAGCTTAGCGGATAAGCAGAC

Table 1

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AAGTTATCTCACAGGTGCATTTACAGGGAGCTTGATCGGTTCTGATGGAACAAAATCGTATGCCATTTA  
TGATTTGAAGAAACCATTATTTGATACATTAATGGTGTCTACAGTTAGAGATTTGGATATTTAAATCTGT  
TTCTGCTGATAGTAAAGAAAATGTCGAGCGCTGGCGAAGGCAGCGAATAGCGCGAATATTAATAATGT  
TGCAGTAGAAGGAAAAATCTCAGGTGCGAAATCTGTTGCGGGATTAGTAGCGAGCGCAACAAATACAGT  
GATAGAAAACAGCTCGTTTACAGGGAACTTATCGCAATCACCAGGACAGTAATAAAAATGATACTGG  
AGGAATAGTAGGTAATATAACAGGAAATAGTTGAGAGTTAATAAAGTTAGGGTAGATGCCTTAATCTC  
TACTAATGCACGCAATAATAACCAACAGCTGGAGGGATAGTAGGTAGATTAGAAAATGGTGCATTGAT  
ATCTAATTCGGTTGCTACTGGAGAAAACGAAATGGTCAAGGATATTCAGAGTCGGAGGAATAGTAGG  
ATCTACGTGGCAAAAACGGTCGAGTAAATAATGTTGTGAGTAACGTAGATGTTGGAGATGGTTATGTTAT  
CACCGGTGATCAATACGCAGCAGCAGATGTGAAAATGCAAGTACATCAGTTGATAATAGAAAAGCAGA  
CAGATTCGCTACAAAATTATCAAAAGACCAAAATAGACGCGAAAGTTGCTGATTATGGAATCACAGTAAC  
TCTTGATGATACTGGGCAAGATTTAAACGTAATCTAAGAGAAGTTGATTATACAGACTAAATAAAGC  
AGAAGCTGAAAGAAAAGTAGCTTATAGCAACATAGAAAACTGATGCCATTCTACAATAAAGACCTAGT  
AGTTCACTATGGTAACAAAGTAGCGACAACAGATAAACTTTACACTACAGAATTGTTAGATTGTTGCC  
GATGAAAGATGATGAAGTAGTAACGGATATTAATAATAAGAAAAATTCATAAATAAAGTTATGTTACA  
TTTCAAAGATAATACAGTAGAATACCTAGATGTAACATTCAAAGAAAACCTCATAAACAGTCAAGTAAT  
CGAATACAATGTTACAGGAAAAGAATATATATTCACACCAGAAGCATTGTTTCAGACTATACAGCGAT  
AACGAATAACGTACTAAGCGACTTGCAAAATGTAACACTTAAC

**SP073 amino acid (SEQ ID NO:122)**

RRYLSLSEAPDTAKYFVKVKSDFKMYLPVKISITENTDGYKVTVAVDQVLEEGTDGYKDDYFTTVA  
KSKAEQPGVYTSFKQLVTAMQSNLSGVYTLASDMTADSVLGDQKTSYLTGAFTGSLIGSDGTSKYAIY  
DLKKPLFDLTNGATVRDLDIKTVSADSKENVAALAKAANSANINNVAVEGKISGAKSVAGLVASATNTV  
IENSFTGKLIANHQDSNKNNDTGGIVGNITGNSSRVNKVRVDALISTNARNNNQTAGGIVGRLENGALI  
SNSVATGEIRNGQGYSRVGGIVGSTWQNGRVNNVSNVDVGDGYVITGDQYAAADVKNASTSVDNRKAD  
RFATKLSKDQIDAKVADYGITVTLDDTGQDLKRNLRVVDYTRLNKAERKVAYSNIEKLMPFYNKDLV  
VHYGNKVATTDKLYTTELLDVVPMKDDVVTDINNKKNSINKVMLHFKDNTVEYLDVTFKENFINSQVI  
EYNVTGKEYIFTPEAFVSDYTAITNNVLSDLQNVTLN

**SP074 nucleotide (SEQ ID NO:123)**

CTTTGGTTTTGAAGGAAGTAAGCGTGGACAATTTGCTGTAGAAGGAATCAATCAACTTCGTGAGCATGT  
AGACACTCTATTGATTATCTCAAACAACAATTTGCTTGAAATTTGTGATAAGAAAACACCGCTTTTGGA  
GGCTCTTAGCGAAGCGGATAACGTTCTTCGTCAAGGTGTTCAAGGGATTACCGATTGATTACCAATCC  
AGGATTGATTAACTTTGACTTTGCCGATGTGAAAACGGTAATGGCAAACAAAGGGAATGCTCTTATGGG  
TATTGGTATCGGTAGTGGAGAAGAACGTGTGGTAGAAGCGGCACGTAAGGCAATCTATTACCACTTCT  
TGAAACAACATATTGACGGTGCTGAGGATGTTATCGTCAACGTTACTGGTGGTCTTGACTTAACCTTGAT  
TGAGGCAGAAGAGGCTTCACAAATTTGTGAACCAGGCAGCAGGTCAAGGAGTGAACATCTGGCTCGGTAC  
TTCAATTGATGAAAGTATGCGTGATGAAATTCGTGTAACAGTTGTTGCAACGGGTCTTCGTCGAAGACCG  
CGTAGAAAAGGTTGTGGCTCCACAAGCTAGATCTGCTACTAACTACCGTGAGACAGTGAACCAGCTCA  
TTCACATGGCTTTGATCGTCAATTTGATATGGCAGAAACAGTTGAATTGCCAAAACAAAATCCACGTCG  
TTTGGAACCAACTCAGGCATCTGCTTTTGGTGATGGGATCTTCGCCGTGAATCGATTGTTTCGTACAAC  
AGATTCAATCGTTTCTCCAGTCGAGCGCTTGAAGCCCCAATTTACAAGATGAAGATGAATTGGATAC  
ACCTCCATTTTTCAAAAATCGT

**SP074 amino acid (SEQ ID NO:124)**

FGFEGSKRGQFAVEGINQLREHVDTLIIISNNNLEIVDKKTPLEALSEADNVLRQGVQGITDLITNP  
GLINLDFADVKTVMANKGNALMGIGIGSGEERVVEAARKAIYSPLLETTIDGAEDVIVNVTGGDLTLI  
EAEEASQIVNQAGQGVNIWLGTSIDESMRDEIRVTVVATGVRQDRVEKVVAPQARSATNYRETVKPAH  
SHGFDRHFDMAETVELPKQNPRRLEPTQASAFGDWDLRRRESIVRTDSVVSPPERFEAPISQDEDELDT  
PPFFKNR

**SP075 nucleotide (SEQ ID NO:125)**

CTACTACCTCTCGAGAGAAAGTGACCTAGAGGTGACCGTTTTTGACCATGAGCAAGGTCAAGCCACCAA  
GGCCGCGAGCAGGAATTATCAGTCCTTGGTTTTCCAAACGGCGTAATAAAGCCTGGTACAAGATGGCGCG  
CTTGGGGGCTGATTTTTATGTGGATTTATTAGCTGATTTAGAGAAATCAGGACAAGAAATCGACTTTTA  
CCAGCGTTCCGGAGTCTTCTCTTGAAAAAGGATGAATCCAATTTGGAAGAACTTTATCAACTGGCCCT  
CCAGCGCAGAGAAGAATCTCCCTTGATAGGCAATTAGCCATTCTGAACCAAGCCTCAGCTAATGAATT  
ATTCCCTGGTTTGAGGGATTGACCGCCTGCTCTATGCTTCTGGTGGAGCGAGAGTAGATGGCCAAT

Table 1

TTTAGTGACTCGTTTGTGGAAGTCAGTCATGTCAAGCTGGTCAAAGAAAAAGTGACTCTGACACCGTT  
AGCATCAGGCTACCAGATTGGTGAAGAGGAGTTTGGCAGGTTATTTTGGCGACGGGAGCTTGGTTGGG  
GGACATGTTAGAGCCTTTAGGTTATGAAGTGGATGTCCGTCCTCAAAAAGGACAACACGAGATTATCA  
GCTTGCCCAAGACATGGAAGATTACCCTGTTGTCATGCCAGAAGGGGAGTGGGATTTGATTCCCTTTGC  
AGGTGGGAAATTATCCTTAGGCGCTACCCACGAAAAATGACATGGGATTTGATTTGACGGTAGATGAAAC  
CTTGCTCCAACAATGGAGGAGGCCACCTTGACTCACTATCTGATTTTGGCTGAAGCTACTTCAAAATC  
TGAGCGTGTGGAATCCGTGCCTACACCAAGTATTTCTCTCCTTTCTTTGGGCAGGTGCCTGACTTAAC  
TGGTGTCTATGCAGCCAGTGGACTAGGTTTCATCAGGCCTCACAACCTGGTCTATCATTGGTTACCATCT  
AGCCCAACTGATCCAAGACAAGGAGTTGACCTTGACCCTCTAAATTACCCAATTGAAACATATGTCAA  
ACGAGTAAAAAGCGAA

**SP075 amino acid (SEQ ID NO:126)**

YYLSRESLEVTVFDEHQGQATKAAAGIISPWF SKRRNKAWYKMARLGADFYVDLLADLEKSGQEIDFY  
QRSGVFLKKDESNLEELYQLALQRREESPLIGQLAILNQASANELFPGLQGDFRLLYASGARVDGQL  
LVTRLLEVSHVKLVKEKVTTLPLASGYQIGEEFEQVILATGAWLGDMLEPLGYEVDVRPQKQQLRDYQ  
LAQDMEDYPVVMPEGEWDLIPFAGGKLSLGATHENDMGFDLTVDETLLQMEELTHYLILAEATSKS  
ERVGIRAYTSDFSPPFGQVPLDTGVYAASGLGSSGLTTGPIIGYHLAQLIQDKELTLDPLNYPYIENVVK  
RVKSE

**SP076 nucleotide (SEQ ID NO:127)**

TAAGGTCAAAAGTCAGACCGCTAAGAAAGTGCTAGAAAAGATTGGAGCTGACTCGGTTATCTCGCCAGA  
GTATGAAATGGGGCAGTCTCTAGCACAGACCATCTTTTCCATAATAGTGTGATGCTTTTCAGTTGGA  
TAAAAATGTGTCTATCGTGGAGATGAAAATTCCTCAGTCTTGGGCAGGTCAAAGCTGAGTAAATTAGA  
CCTCCGTGGCAAATACAATCTGAATATTTTGGGTTTCCGAGAGCAGGAAAATCCCCATTGGATGTTGA  
ATTTGGACCAGATGACCTCTTGAAAGCAGATACCTATATTTTGGCAGTCATCAACAACCAAGTATTTGGA  
TACCCTA

**SP076 amino acid (SEQ ID NO:128)**

KVKSGTAKKVLKIGADSVISPEYEMGQSLAQTLFHNVSVDVFLDKNVSIIVEMKIPQSWAGQSLSKLD  
LRGKYNLNLGFREQENSPLDVEFGPDDLKADTYILAVINNQYLDL

**SP077 nucleotide (SEQ ID NO:129)**

TGACGGGTCTCAGGATCAGACTCAGGAAATCGCTGAGTGTCTTAGCTAGCAAGTATCCTAATATCGTTAG  
AGCCATCTATCAGGAAATAAATGCCATGGCGGTGCGGTCAATCGTGGCTTGGTAGAGGCTTCTGGGCG  
CTATTTTAAAGTAGTTGACAGTGATGACTGGGTGGATCCTCGTGCTACTTGAAAATCTTGAAACTTG  
CAGGAACCTTGAGAGCAAAGGTCAAGAGGTGGATGCTCTTTG

**SP077 amino acid (SEQ ID NO:130)**

DGSQDQTQEIACLASKYPNIVRAIYQENKCHGAVNRLVEASGRYFKVVDSDDWVDPAYLKILETC  
RNLRAKVKRWMSL

**SP078 nucleotide (SEQ ID NO:131)**

TAGAGGCTTTGCCAAATGGTGGGAAGGGCACGAGCGTCGAAAAGAGGAACGCTTTGTCAAACAAGAAGA  
AAAAGCTCGCCAAAAGGCTGAGAAAGAGGCTAGATTAGAACAAGAAGAGACTGAAAAAGCCTTACTCGA  
TTTGCCCTCTGTGATATGGAACGGGTGAAATCTGACAGAGGAAGCTGTTCAAATCTTCCACCTAT  
TCCAGAAGAAAAGTGGGTGGAACAGAAATCATCCTGCCTCAAGCTGAACTTAAATTCCTTGAACAGGA  
AGATGACTCAGATGACGAAGATGTTTCAGGTGATTTTTCAGCCAAAGAAGCCCTTGAATACAACTTCC  
AAGCTTACAACCTTTTGACCAGATAAACCAAAAGATCAGTCTAAAGAGAAGAAAATTGTGAGAGAAA  
TATCAAAATCTTAGAAGCAACCTTTGCTAGCTTTGGTATTAAGGTAACAGTTGAACGGGCCGAAATTGG  
GCCATCAGTGACCAAGTATGAAGTCAAGCCGGCTGTTGGTGTAAGGTCACCGCATTTCCAATCTATC  
AGATGACCTCGCTCTAGCCTTGGCTGCCAAAGATGTCCGATTGAAGCACCAATCCCTGGGAAATCCCT  
AATCGGAATTGAAGTGCCCAACTCCGATATTGCCACTGTATCTTTCCGAGAACTATGGGAACAAATCGCA  
AACGAAAGCAGAAAATTTCTTGGAAAATCTTTTAGGGAAGGCTGTTAATGGAACCGCAAGAGCTTTTGA  
CCTTTCTAAATGCCCCACTTGCTAGTTGCAGGTTCAACGGGTTTCAGGGAAGTCAGTAGCAGTTAACGG  
CATTATCTTAGCATTCTCATGAAGGCGAGACCAGATCAAGTTAAATTTATGATGGTCGATCCCAAGAT  
GGTTGAGTTATCTGTTTACAATGATATTTCCCACTCTTGATTCCAGTCGTGACCAATCCACGCAAGC  
CAGCAAGGCTCTGAAAAGGTTGTGGATGAAATGGAAAACCGTTATGAACTCTTTGCCAAGGTGGGAGT  
TCGGAATATTGCAGGTTTAAATGCCAAGGTAGAAGAGTTCAATTCCAGTCTGAGTACAAGCAAAATTC

Table 1

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GCTACCATTTCATTGTCGTGATTGTGGATGAGTTGGCTGACCTCATGATGGTGGCCAGCAAGGAAGTGGAA  
AGATGCTATCATCCGCTCTTGGGCAGAAAGGCGCTGCTGCAGGTATCCACATGATTCTTGCAACTCAGCG  
TCCATCTGTTGATGTCATCTCTGGTTTGATTAAGGCCAATGTTCCATCTCGTGTAGCATTGCGGGTTTC  
ATCAGGAACAGACTCCCGTACGATTTTGGATGAAAATGGAGCAGAAAAAATTCTTGGTTCGAGGAGACAT  
GCTCTTTAAACCGATTGATGAAAATCATCCAGTTCGTCTCCAAGGCTCCTTTATCTCGGATGACGATGT  
TGAGCGCATTTGTGAACCTCATCAAGACTCAGGCAGATGCAGACTACGATGAGAGTTTTGATCCAGGTGA  
GGTTTCTGAAAATGAAGGAGAATTTTCGGATGGAGATGCTGGTGGTATCCGCTTTTGAAGAAGCTAA  
GTCTTTGGTTATCGAAACACAGAAAGCCAGTGCCTCTATGATTACGCGTCGTTTATCAGTTGGATTAA  
CCGTGCGACCCGCTCATGGAAGAAGTGGAGATAGCAGGTGTCATCGGTCCAGCTGAAGGTACCAAAC  
TCGAAAAGTGTTACAACAA

**SP078 amino acid (SEQ ID NO:132)**

RGFAKWWEGHERRKEERFVKQEEKARQKAEKEARLEQEETEKALLDLPPVDMETGEILTEEAVQNLPPI  
PEEKWVEPEIILPQAEKLFPEQEDSDDEDVQVDFSAKEALEYKLPQLFAPDKPKDQSEKKIVREN  
IKILEATFASFGIKVTVERAEIGPSVTKYEVKPAVGVRVNRISNLSDDLALALAAKDVRIEAPIGKSL  
IGIEVPNSDIATVSFRELWEQSQTKAENFLEIPLGKAVNGTAPAFDLSKMPHLLVAGSTGSGKSVAVNG  
IIASILMKARPDQVKFMMVDPKMWELSVYNDI PHLLI PVVTNPRKASKALQKVVDENENRYELFAKVG  
RNIAGFNAKVEEFNSQSEYKQIPLPFIVVIVDELADLMMVASKEVEDAIIRLGQKARAAGIHMLATQR  
PSVDVISGLIKANVPSRVAFVSSGTSRITLDENGAEKLLGRGDMFLFKPIDENHPVRLQGSFISDDDV  
ERIVNFIKTQADADYDESFDPGEVSENEGEFSDBGDAGDPLFEAKSLVIETQKASASMIQRRLSVGFN  
RATRLMEELEIAGVIGPAEGTKPRKVLQQ

**SP079 nucleotide (SEQ ID NO:133)**

TCAAAAAGAGAAGGAAAACCTTGGTTATTGCTGGGAAAATAGGTCCAGAACAGAAAATTTGGCCAATAT  
GTATAAGTTGCTGATTGAAGAAAATACCAGCATGACTGCGACTGTAAACCGAATTTTGGGAAGACAAG  
CTTCTCTTTATGAAGCTCTGAAAAAAGGCGATATTGACATCTATCCTGAATTTACTGGTACGGTGACTGA  
AAGTTTGCTTCAACCATCACCCAAGGTGAGTCATGAACCAGAACAGGTTTATCAGGTGGCGCGTGATGG  
CATTGCTAAGCAGGATCATCTAGCCTATCTCAAACCATGTCTTATCAAACACCTATGCTGTAGCTGT  
TCCGAAAAGATTGCTCAAGAATATGGCTTGAAGACCATTTCAGACTTGAAAAAAGTGGAAAGGGCAGTT  
GAAGGCAGGTTTTACTACTCGAGTTTAAAGACCGTGAAGATGGAATAAGGGCTTGCAATCAATGTATGG  
TCTCAATCTCAATGTAGCGACCATTTAGCCAGCCCTTCGCTATCAGGCTATTTCAGTCAGGGGATATTCA  
AATCAGGATGCCTATTCGACTGATGCGGAATTGGAGCGTTATGATTTACAGGCTTTGGAAGATGACAA  
GCAACTCTTCCCACCTTATCAAGGGGCTCCACTCATGAAAGAAGCTCTTCTCAAGAAACACCCAGAGTT  
GGAAAGAGTTCTTAATACATTGGCTGGTAAGATTACAGAAAGCCAGATGAGCCAGCTCAACTACCAAGT  
CGGTGTTGAAGGCAAGTCAGCAAAGCAAGTAGCCAAGGAGTTTCTCCAAGAACAAGGTTTGTGAAGAA  
A

**SP079 amino acid (SEQ ID NO:134)**

QKEKENLVIAGKIGPEPEILANMYKLLIEZENTSMTATVKPNFGKTSFLYEALKKGDDIDIYPEFTGTVTE  
SLLQPSPKVSHEPEQVYQVARDGIKQDHLAYLKPMYQNTYAVAVPKKIAQEYGLKTIISDLKKVEGQL  
KAGFTLEFNDREDGNKGLQSMYGLNLNVATIEPALRYQAIQSGDIQITDAYSTDAELERYDLQVLEDDK  
QLFPYPYQGAPLMKEALLKKHPELRLVNTLAGKITESQMSQLNYQVGVGKSAKQVAKEFLQEGLLKK

**SP080 nucleotide (SEQ ID NO:135)**

ACGTTCTATTGAGGACCACTTTGATTCAAACCTCGAATTGGAATATAACCTCAAAGAAAAAGGAAAAAC  
AGATCTTTTGAAGCTAGTTGATAAAACAACCTGACATGCGTCTGCATTTTATCCGCCAAACTCATCCACG  
CGGTCTCGGAGATGCTGTTTTCGAAGCCAAGGCTTTCGTCGGAAATGAACCTTTTGTGCTTATGCTTGG  
TGATGACTTGATGGATATCACAGACGAAAAGGCTGTTCCACTTACCAAAACAACCTCATGGATGACTACGA  
GCGTACCCACGCGTCTACTATCGCTGTCTATGCCAGTCCCTCATGACGAAGTATCTGCTTACGGGGTTAT  
TGCTCCGCAAGGCGAAGGAAAAGATGGTCTTTACAGTGTGAAACCTTTGTGAAAAACAGCTCCAGA  
GGACGCTCCTAGCGACCTTGCTATTATCGGACGCTACCTCCTCAGCCTGAAATTTTGAGATTCTCGA  
AAAGCAAGCTCCAGGTGCAGGAAATGAAATTCAGCTGACAGATGCAATCGACACCTCAATAAAACACA  
ACGTGTATTTGCTCGTGAGTTCAAAGGGGCTCGTTACGATGTGCGAGACAAGTTTGGCTTCATGAAAA  
ATCCATCGACTACGCCCTCAAACACCCACAAGTCAAAGATGATTGAAGAATTACCTCATCCAACCTTGG  
AAAAGAATTGACTGAGAAGGAA

Table 1

**SP080 amino acid (SEQ ID NO:136)**

RSIEDHFDNSNFELEYNLKEKGKTDLLKLVDKTTDMRLHFIRQTHPRGLGDAVLQAKAFVGNPEFVVMGLG  
DDLMDITDEKAVPLTKQLMDDYERTHASTIAVMPVPHDEVSAVGVIAPQGEKDGGLYSVETFEKPAPE  
DAPSDLAIIGRYLLTPEIFEILEKQAPGAGNEIQLTDAIDTLNKTQRVFAREFKGARYDVGDKFGFMKT  
SIDYALKHPQVKDDLKNYLIQLGKELTEKE

**SP081 nucleotide (SEQ ID NO:137)**

CGCTCAAAATACCAGAGGTGTTACAGCTAATCGAGCACGTTTCTCCTCAAATGTTGAAAGCCCAATTGGA  
GAGTGTCTTTTCTGATATTCCACCTCAGGCTGTAAAACTGGAAATGTTGGCTACTACTGAAATCATGGA  
AATCATCCAACCTATCTTAAAAAAGTGGATTGTCCCTATGTCTTGATCTGTTATGGTTGCTACAAG  
TGGAGATGCCTTGATTGACTCAAATGCTAGAGACTATCTCAAAACAACTTACTACCTCTAGCAACTAT  
TATTACGCCAAATCTTCTGAAGCAGAAGAGATTGTTGGTTTTTCAATCCATGACCCCGAAGACATGCA  
CGCTGCTGGTGCCTGATTTTAAAGAATTGTTGCTCCTCAGTCTGTGGTTATCAAAGCGGACATCTCAA  
AGGTGGTGCTAAAGATTCTCTTTACCAAGAATGAACAATTTGCTGGGAAAGCCACGAATTCAAAC  
CTGTACACCCATGGTACT

**SP081 amino acid (SEQ ID NO:138)**

AQNTRGVQLIEHVSQMLKAQLESVFS DIPQAVKTGMLATTEIMEIIQPYLKKLDCPYVLDPMVATS  
GDALIDSNARDYLKTNLLPLATIIITPNLPEAEIIVGFSIHDPEDMQRAGRLLILKEFGPQSVVIKGGHLK  
GGAKDFLFTKNEQFVWESPRIQTCHTHGT

**SP082 nucleotide (SEQ ID NO:139)**

AATTGTACAATTAGAAAAAGATAGCAAATCAGACAAAGAACAAGTTGATAAACTATTTGAATCATTGGA  
TGCATCTTCAGATGAATCTATTTCTAAATTAAAAAGAACTATCTGAACTTCACTTAAAACCGATGCAGG  
TAAAGACTATCTTAAATAACAAAGTCAAAGAATCATCTAAAGCAATTGTAGATTTTCATTTGCAAAAAGG  
TTTGGCTTATGATGTTAAAGATTGATGACAAATTTAAAGATAAAGCAACTCTTGAAACAAATGTAAA  
AGAAATTACAAAACAAATTGATTTTATCAAAAAAGTTGATGAACTTTTAAACAAGAGAATTGGAAGA  
AACTCTTAAATCTCTAAATGATCTTGTGATAAATATCAAAAACAAATCGAACTTTTGAAGAAAGAAGA  
AGAAAAAGCTGCTGAAAAAGCTGCTGAAAAAGCAAAGGAATCTTCTAGTCAAAGTAATCTCTGCTAG  
TGCTTCTAATGAGTCTTATAATGGATCTTCCAATTCAAATGTAGATTATAGTTCATCTGAACAACTAA  
TGGATATTCAAATAATTATGGCGGTCAAAGATTATCTGGTTCAGGAGATAGTTCAACAAATGGTGGATC  
ATCAGAACAATATTCTATCTAGCAATTCAAACAGCGGAGCAAATAATGTCTACAGATATAAAGGCACTGG  
TGCTGACGGCTATCAAAGATACTACTACAAAGATCATAATAATGGAGATGTGTATGATGACGATGGAAA  
TTACCTTGGGAACCTTGGTGGCGGCATTGCAGAACCTAGTCAACGC

**SP082 amino acid (SEQ ID NO:140)**

IVQLEKDSKSDKEQVDKLFESFDASSDESISKLELSETSLKTDAGKDYLNNKVKESSKAIVDFHLQKG  
LAYDVKSDDDKFKDKATLETNVKEITKQIDFIKKVDETFKQENLEETLKS LNDLVDKYQKQIELLKKEE  
EKAAEKAAEKAKESSQSNSSGSASNESYNGSSNSNVDSSEQTNGYSNNYGGQDYSGSGDSSTNGGS  
SEQYSSSNSNSGANNVYRYKGTGADGYQRYYYKDHNNGDVYDDDGNYLGNFGGGIAEPSQR

**SP083 nucleotide (SEQ ID NO:141)**

TCTGACCAAGCAAAAAGAAGCAGTCAATGACAAAGGAAAAGCAGCTGTTGTTAAGGTGGTGGAAAGCCA  
GGCAGAACTTTATAGCTTAGAAAAGATGAAGATGCTAGCCTAAGAAAGTTACAAGCAGATGGACGCAT  
CACGGAAGAACAGGCTAAAGCTTATAAAGAATACAATGATAAAATGGAGGAGCAAATCGTAAAGTCAA  
TGAT

**SP083 amino acid (SEQ ID NO:142)**

LTKQKEAVNDKGAAVVKVVEQAELYSLEKNEDASLRKLQADGRITEEQAKAYKEYNDKNGGANRKNV  
D

**SP084 nucleotide (SEQ ID NO:143)**

GTCCGGCTCTGTCCAGTCCACTTTTTCAGCGGTAGAGGAACAGATTTTCTTTATGGAGTTTGAAGAACT  
CTATCGGGAACCCAAAAACGAGTGTAGCCAGTCAGCAAAAGACTAGTCTGAACCTTAGATGGGCAGAC  
GCTTAGCAATGGCAGTCAAAAGTTGCCAGTCCCTAAAGGAATTCAGGCCCATCAGGCCAAAGTATTAC  
ATTTGACCGAGCTGGGGCAATTCTGTCCTGGCTAAGGTTGAATTCAGACCAGTAAAGGAGCGATTCCG  
CTATCAATTATATCTAGGAAATGAAAAATTAACGCATTAAGGAAACAAAAAT



Table 1

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**SP084 amino acid (SEQ ID NO:144)**

SGSVQSTFSAVEEQIFFMEFEELYRETQKRSVASQQKTSNLNDGQTLNNGSQKLPVPKGIQAPSGQSI  
FDRAGGNSSLAKVEFQTSKGAIRYQLYLNGNKKIKRIKETKN

**SP085 nucleotide (SEQ ID NO:145)**

GGGACAAATTCAAAAAATAGGCAAGAGGAAGCAAAATCTTGCAAAAGGAAGAAGTCTTGAGGGTAGC  
TAAGATGGCCCTGCAGACGGGGCAAAATCAGGTAAGCATCAACGGAGTTGAGATTACAGTATTTCTAG  
TGAAAAAGGATTGGAGGTCTACCATGGTTCAGAACAGTTGTTGGCAATCAAAGAGCCA

**SP085 amino acid (SEQ ID NO:146)**

GQIQKNRQEEAKILQKEEVLRLVAKMALQTGQNVQVSINGVEIQVFSSEKGLVYHGSQQLLAIKEP

**SP086 nucleotide (SEQ ID NO:147)**

TCGCTACCAGCAACAAAGCGAGCAAAAGGAGTGGCTCTTGTGTTGGACCAACTTGAGGTAGAATTAGA  
CCGTTTCGCAGTTGCAAAAAGTAGAAGGCAATCGCTTATACATGAAGCAAGATGGCAAGGACATCGCCAT  
CGGTAAGTCAAAGTCAGATGATTTCCGTAAAACGAATGCTCGTGGTCGAGGTTATCAGCCTATGGTTTA  
TGGACTCAAATCTGTACGGATTACAGAGGACAATCAACTGGTTCGCTTTTCCAGTTCCAAAAAGG  
CTTAGAAAGGGAGTTCATCTATCGTGTGGAAAAAGAAAAAGT

**SP086 amino acid (SEQ ID NO:148)**

RYQQQSEQKEWLLFVDQLEVELDRSQFEKVEGNRLYMKQDGKDIAIGKSKSDDFRKTNARGRGYQPMVY  
GLKSVRITEDNQLVRHFHFQKGLEREFYRVEKEKS

**SP087 nucleotide (SEQ ID NO:149)**

GAACCGACAAGTCGCCACTATCAAGACTATGCTTTGAATAAAGAAAAATTGGTTGCTTTTGCTATGGC  
TAAACGAACCAAGATAAGGTTGAGCAAGAAAGTGGGGAACAGTTTAAATCTAGGTCAGGTAAAGCTA  
TCAAAACAAAGAAACTGGCTTAGTGACGAGGGTTCGTACGGATAAGAGCCAATATAGATTTCTGTTTCC  
TTCAGTCAAATCAAAGAAGAGAAAAAGATAAAAAAGGAAGAGGTAGCGACCGATTCAAGCGAAAAAGT  
GGAGAAGAAAAATCAGAAGAGAAGCCTGAAAAGAAAGAGAATTCA

**SP087 amino acid (SEQ ID NO:150)**

NRQVAHYQDYALNKEKLVAFAMAKRTKDKVEQESGEQFFNLGQVSYQNKKTGLVTRVRTDKSQYEFLFP  
SVKIKEEKRDKEEVATDSSEKVEKKKSEKPEKKENS

**SP088 nucleotide (SEQ ID NO:151)**

GGTTGTCCGCTGGCAATATATCCCGTTCCATCTAAAGGTAGTACAATTGGTCCTTACCCAAATGGTAT  
CAGATTAGAAGGTTTCCAAAGTCAGAGTGGTACTACTTCGATAAAAAATGGAGTGCTACAAGAGTTTGT  
TGGTTGGAAAACATTAGAGATTAAACTAAAGACAGTGTTGGAAGAAAGTACGGGGAAAAACGTGAAGA  
TTCAGAAGATAAAGAAGAGAAGCGTTATTATACGAATATTACTTTAATCAAAATCATTTCTTTAGAGAC  
AGGTTGGCTTTATGATCAGTCTAACTGGTATTATCTAGCTAAGACGGAAATTAATGGAGAAAACTACCT  
TGGTGGTGAAAGACGTGCGGGGTGGATAAACGATGATTCGACTTGGTACTACCTAGATCCAACAACCTGG  
TATTATGCAACAGGTTGGCAATATCTAGGTAATAAGTGGTACTACCTCCGTTCTCAGGAGCAATGGC  
CACTGGCTGGTATCAGGAAGGTACCACTTGGTATTATTTAGACCACCCAAATGGCGATATGAAAACAGG  
TTGGCAAAACCTTGGGAACAAATGGTACTATCTCCGTTTCATCAGGAGCTATGGCAACTGGTTGGTATCA  
AGATGGTTCAACTTGGTACTACCTAAATGCAGGTAATGGAGACATGAAGACAGGTTGGTTCCAGGTCAA  
TGGCAACTGGTACTATGCTTATAGCTCAGGTGCTTTGGCAGTGAATACGACCGTAGATGGCTATTCTGT  
CAACTATAATGGCGAATGGGTTCCG

**SP088 amino acid (SEQ ID NO:152)**

VVGWQYIPFPSKSTIGPYPNGIRLEGFPKSEWYFDPKNGVLQEFVGWKTLEIKTKDSVGRKYGEKRED  
SEDKEEKRYTNYFQNHSLQETGWLYDQSNWYLLAKTEINGENYLGGERAGWINDSTWYLYLDPPTG  
IMQTGWQYLGKWKYLLRSSGAMATGWYQEGTTWYLLDHPNGDMKTGWQNLGNKWKYLLRSSGAMATGWYQ  
DGSTWYLLNAGNGDMKTGWQVNGNWKYAYSSGALAVNTTVDGYSVNYNGEWR

**SP089 nucleotide (SEQ ID NO:153)**

GGCCAAATCAGAATGGGTAGAAGACAAGGGAGCCTTTTATTATCTTGACCAAGATGGAAGATGAAAA  
AAATGCTTGGGTAGGAACCTCCTATGTTGGTGCAACAGGTGCCAAAGTAATAGAAGACTGGGTCTATGA  
TTCTCAATACGATGCTTGGTTTTATATCAAAGCAGATGGACAGCACGAGAGAAAGAATGGCTCCAAAT

Table 1

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TAAAGGGAAGGACTATTATTTCAAATCCGGTGGTTATCTACTGACAAGTCAGTGGATTAATCAAGCTTA  
 TGTGAATGCTAGTGGTGCCAAAGTACAGCAAGGTTGGCTTTTGGACAAACAATACCAATCTTGGTTTTA  
 CATCAAAGAAAATGGAACTATGCTGATAAAGAATGGATTTTCGAGAATGGTCACTATTATTATCTAAA  
 ATCCGGTGGCTACATGGCAGCCAATGAATGGATTTGGGATAAGGAATCTTGGTTTTATCTCAAATTTGA  
 TGGGAAAATGGCTGAAAAAGAATGGGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCCGG  
 TGGTTACATGACAGCCAATGAATGGATTTGGGATAAGGAATCTTGGTTTTATCTCAAATCTGATGGGAA  
 AATAGCTGAAAAAGAATGGGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCCGGTGGTTA  
 CATGACAGCCAATGAATGGATTTGGGATAAGGAATCTTGGTTTTACCTCAAATCTGATGGGAAAATAGC  
 TGA AAAAGAATGGGTCTACGATTCTCATAGTCAAGCTTGGTACTACTTCAAATCTGGTGGCTACATGGC  
 GAAAAATGAGACAGTAGATGTTTATCAGCTTGAAGCGATGGTAAATGGCTTGGAGGAAAAACTACAAA  
 TGA AAAATGCTGCTTACTATCAAGTAGTGCCTGTTACAGCCAATGTTTATGATTAGATGGTGA AAAAGCT  
 TTCTTATATATCGCAAGGTAGTGTCTGATGGCTAGATAAGGATAGAAAAAGTATGACAAGCGCTTGGC  
 TATTACTATTTCTGGTTTGTGAGCTATATGAAAACAGAAGATTTACAAGCGCTAGATGCTAGTAAGGA  
 CTTTATCCCTTATTATGAGAGTGATGGCCACCGTTTTTATCACTATGTGGCTCAGAATGCTAGTATCCC  
 AGTAGCTTCTCATCTTTCTGATATGGAAGTAGGCAAGAAATATTATTCGGCAGATGGCCTGCATTTTGA  
 TGGTTTTAAGCTTGAAGTCCCTTCTTTTCAAAGATTTAACAGAGGCTACAACTACAGTGTGAAGA  
 ATTGGATAAGGTATTAGTTTGGCTAAACATTAACAATAGCCTTTTGGAGAACAGGGCGCTACTTTTAA  
 GGAAGCCGAAGAACATTACCATATCAATGCTCTTTATCTCCTTGCCCATAGTGCCTTAGAAAGTAAGT  
 GGAAGAAGTAAATTGCCAAAGATAAGAATAATTCTTTGGCATTACAGCCTATGATACGACCCCTTA  
 CCTTTCTGCTAAGACATTTGATGATGTGGATAAGGGAATTTTAGGTGCAACCAAGTGGATTAAAGGAAA  
 TTATATCGATAGGGGAAGAACTTTCTTGGAAACAAGGCTTCTGGTATGAATGTGAATATGCTTCAGA  
 CCCTTATTGGGGCGAAAAATTGCTAGTGTGATGATGAAAAATCAATGAGAAG

**SP089 amino acid (SEQ ID NO:154)**

AKSEWVEDKGAFYYLDQDGMKRNWVGTSTVVGATGAKVIEDWVYDSQYDAWFIKADGQHAKEWLQI  
 KGKDYFFKSGGYLLTSQWINQAYVNASGAKVQGGWLFQKQYQSWFIKENGNYADKEWIFENGHYIYK  
 SGGYMAANEWIWDKESWFIYKFDGKMAKEWVYDSHSQAWYFYKSGGYMTANEWIWDKESWFIYKSDGK  
 IAEKEWVYDSHSQAWYFYKSGGYMTANEWIWDKESWFIYKSDGKIAEKEWVYDSHSQAWYFYKSGGYMA  
 KNETVDGYQLGSDGKWLGGKTTNENAAYYQVVPVTANVYDSGKLSYISQGSVWLDRKSDDKRLA  
 ITISGLSGYMKTEDLQALDASKDFIPYYESDGHRYFYHYVAQNASI PVASHLSDMEVGKKYYSADGLHFD  
 GFKLENPFLLFKDLTEATNYSAEELDKVFSLLNINNSLLENKGATFKEAEEHYHINALYLLAHSALSNW  
 GRSKIAKDKNNFFGITAYDTPYLSAKTFDDVDKILGATKWIKENYIDRGRTFLGNKASGMNVEYASD  
 PYWGEKIASVMMKINEK

**SP090 nucleotide (SEQ ID NO:155)**

ATTTGCAGATGATTCTGAAGGATGGCAGTTTGTCCAAGAAAATGGTAGAACCTACTACAAAAAGGGGGA  
 CTTAAAAGAAACCTACTGGAGAGTGATAGATGGGAAGTACTATTATTTGATCCTTTATCCGGAGAGAT  
 GGTGTGCGCTGGCAATATATACCTGCTCCACACAAGGGGTTACGATTGGTCTTCTCCAAGAATAGA  
 GATTGCTCTTAGACCAGATTGGTTTTATTTTGGTCAAGATGGTGTATTACAAGAATTTGTTGGCAAGCA  
 AGTTTTAGAAAGCAAAAACCTGCTACGAATACCAACAACATCATGGGGAAGAATATGATAGCCAAGCAGA  
 GAAACGAGTCTATTATTTTGAAGATCAGCGTAGTTATCATACTTTAAAAACTGGTTGGATTATGAAGA  
 GGGTCATTGGTATTATTTACAGAAGGATGGTGGCTTTGATTGCGCATCAACAGATTGACGGTTGGAGA  
 GCTAGCACGTGGTTGGGTTAAGGATTACCCTCTTACGTATGATGAAGAGAAGCTAAAAGCAGCTCCATG  
 GTACTATCTAAATCCAGCAACTGGCATTATGCAAAACAGGTTGGCAATATCTAGGTAATAGATGGTACTA  
 CCTCCATTGCTCAGGAGCTATGGCAACTGGCTGGTATAAGGAAGGCTCAACTTGGTACTATCTAGATGC  
 TGA AAAATGGTGATATGAGAACTGGCTGGCAAAACCTTGGGAACAAATGGTACTATCTCCGTTTCATCAGG  
 AGCTATGGCAACTGGTTGGTATCAGGAAAGTTCGACTTGGTACTATCTAAATGCAAGTAATGGAGATAT  
 GAAAAACAGGCTGGTTCCAAGTCAATGGTAACTGGTACTATGCCTATGATTCAGGTGCTTTAGCTGTAA  
 TACCACAGTAGGTGGTTACTACTTAAACTATAATGGTGAATGGGTTAAG

**SP090 amino acid (SEQ ID NO:156)**

VFADDSEGVQFVQENGRYYKKGDLKETYWRVIDGKYYYFDPLSGEMVVGWQYIPAPHKGVITIGPSPRI  
 EIALRPDWFYFGQDGVLEFVGKQVLEAKTATNTNKHHEEYDSQAERVYFYFEDQRSYHTLKTGWIYE  
 EGHWYLLQKDGDFDSRINRLTVGELARGWKDYPLTYDEEKLKAAPWYILNPATGIMQTGWQYLGNRWY  
 YLHSSGAMATGWYKEGSTWYLLDAENGDMRTGWQNLGNKWYILRSSGAMATGWYQESSWYLLNASNGD  
 MKTGWFQVNGNWYAYDSGALAVNTTVGGYLLNYNGEWWK

Table 1

**SP091 nucleotide (SEQ ID NO:157)**

TGTCGCTGCAAATGAACTGAAAGTAGCAAAAACCTTCGCAGGATACAACGACAGCTTCAAGTAGTTCAGAGCAAAAATCAGTCTTCTAATAAAACGCAACGAGCGCAGAAGTACAGACTAATGCTGCTGCCACTGGGA  
TGGGGATTATTATGTAAAGGATGATGGTTCTAAAGCTCAAAGTGAATGGATTTTGTACAACACTACTATAA  
GGCTTGGTTTATATTAATTCAGATGGTCGTTACTCGCAGAATGAATGGCATGGAAATTACTACCTGAA  
ATCAGGTGGATATATGGCCCAAAACGAGTGGATCTATGACAGTAATTACAAGAGTTGGTTTATCTCAA  
GTCAGATGGGGCTTATGCTCATCAAGAATGGCAATTGATTGGAAATAAGTGGTACTACTTCAAGAAAGTG  
GGTTACATGGCTAAAAGCCAATGGCAAGGAAGTTATTTCTTGAATGGTCAAGGAGCTATGATGCAAAA  
TGAATGGCTSCTATGATCCAGCCTATTCTGCTTATTTTATCTAAAATCCGATGGAACTTATGCTAACC  
AAGAGTGGCAAAAGTGGCGGCAAAATGGTACTATTTCAAGAAGTGGGGCTATATGGCTCGGAATGAGT  
GGCAAGGCAACTACTATTTGACTGGAAGTGGTGCCATGGCGACTGACGAAGTGATTATGGATGGTACTC  
GCTATATCTTTGCGGCCCTCTGGTGAGCTCAAAGAAAAAAGATTTGAATGTCGGCTGGGTTACACAGAG  
ATGGTAAGCGCTATTTCTTTAATAATAGAGAAGAACAAGTGGGAACCGAACATGCTAAGAAAGTCAATG  
ATATTAGTGAGCACAATGGTCGTATCAATGATTTGGAAAAAGTTATTGATGAGAACGAAGTGGATGGTG  
TCATTGTTCTGCTAGTTATAGCGGTAAAGAAGACAAGGAATTGGCGCATAACATTAAGGAGTTAAACC  
GTCTGGGAATTCCTTATGGTGTCTATCTCTATACCTATGCTGAAAATGAGACCGATGCTGAGAGTGACG  
CTAAACAGACCATTGAACCTTATAAAGAAATACAATATGAACCTGTCTTACCCTATCTATTATGATGTTG  
AGAAATTGGGAATATGTAAATAGAGCAAGAGAGCTCCAAGTGATACAGGCACCTTGGGTTAAAAATCATCA  
ACAAGTACATGGACACGATGAAGCAGGCGGGTTATCAAAATGTGTATGTCTATAGCTATCGTAGTTTAT  
TACAGACGCGTTTAAACACCCAGATATTTTAAACATGTAAACTGGGTAGCGGCTATACGAATGCTT  
TAGAATGGGAAAACCTCATTTATTCAGGAAAAAAGGTTGGCAATATACCTCTTCTGAATACATGAAAG  
GAATCCAAGGCGCGTAGATGTCAGCGTTTGGTAT

**SP091 amino acid (SEQ ID NO:158)**

VAANETEVAKTSQDTTASSSSSEQNQSSNKTQTSAEVQTNAAHWDGDYVVKDDGSKAQSEWIFDNYK  
AWFYINSDGRYSQNEWHGNYLYKSGGYMAQNEWIYDSNYKSWFYLKSDGAYAHQEWQLIGNKWYFFKKW  
GYMAKSQWQGSYFLNGQGAMMONEWLYDPAYSAYFYLYKSDGTYANQEWQKVGKWWYFFKKWGYMARNEW  
QGNYYLTGSGAMATDEVIMDGTRYIFAASGELKEKKDLNVGWVHRDQKRYFFNNREEQVGTGHAHAKVID  
ISEHNGRINDWKVIDENEVDGVIVRLGYSGKEDKELAHNIKELNRLGIPYGVVLYTYAENETDAESDA  
KQTIELIKKYNMNLSPYIYDVENWEYVYVNSKRAPSDGTWVKIINKYMDTMKQAGYQNVVYVYSRSL  
QTRLKHPDILKHVNWVAAYTNALWENPHYSKKGWQYTSSEYMKGIQGRVDVSVWY

**SP092 nucleotide (SEQ ID NO:159)**

TACGCTCTCAGCCTACTTTTGTAAAGAGCAGAAGATCTCCACAAGTTGTCGAAAAATCTTCATTAGAGAA  
GAAATATGAGGAAGCAAAAGCAAAAGCTGATACTGCCAAGAAAGATTACGAAACGGCTAAAAAGAAAGC  
AGAAGACGCTCAGAAAAAGTATGAAGATGATCAGAAGAGAACTGAGGAGAAAGCTCGAAAAGAACGAGA  
AGCATCTCAAAAATTGAATGATGTGGCGCTTGTGTTCAAAATGCATATAAAGAGTACCCGAGAAGTTCA  
AAATCAACGTAGTAAATATAAATCTGACGCTGAATATCAGAAAAAATTAACAGAGGTGACCTCTAAAT  
AGAGAAGGCTAGGAAAGAGCAACAGGACTTGCAAAATAAATTTAATGAAGTAAGAGCAGTTGTAGTTCC  
TGAACCAATATGCTTGGCTGAGACTAAGAAAAAGCAGAAGAAGCTAAAGCAGAAGAAAAAGTAGCTAA  
GAGAAAAATATGATTATGCAACTCTAAAGGTAGCACTAGCGAAGAAAGAAAGTAGAGGCTAAGGAACCTGA  
AATTGAAAAACTTCAATATGAAATTTCTACTTTGGAACAAGAAGTTGCTACTGCTCAACATCAAGTAGA  
TAATTTGAAAAACTTCTTGCTGGTGCGGATCCTGATGATGGCACAGAAGTTATAGAAGCTAAATTTAA  
AAAAGGAGAAGCTGAGCTAAACGCTAAACAAGCTGAGTTAGCAAAAAAACAAACAGAACTTGA AAAACT  
TCTTGACAGCCTTGATCCTGAAGGTAAAGCTCAGGATGAATTAGATAAAGAAAGCAGAAGAAGCTGAGTT  
GGATAAAAAAGCTGATGAACCTCAAAATAAAGTTGCTGATTTAGAAAAAGAAATTAGTAACCTTGAAAT  
ATTACTTGGAGGGGCTGATNCTGAAGATGATACTGCTGCTCTTCAAAATAAATTAGCTACTAAAAAGC  
TGAATTGGAAAAAACTCAAAAAGAATTAGATGCAGCTCTTAATGAGTTAGGCCCTGATGGAGATGAAGA  
AGAAACTCCAGCGCCGGCTCCTCAACCAGAGCAACCAGCTCCTGCACCAAAACAGAGCAACCAGCTCC  
AGCTCCAAAACAGAGCAACCAGCTCCTGCACCAAAACAGAGCAACCAGCTCCAGCTCCAAAACAGAG  
GCAACCAGCTCCAGCTCCAAAACAGAGCAACCAGCTAAGCCGGAGAAACAGCTGAAGAGCCTACTCA  
ACCAGAAAAACAGCCACTCCAAAACAGGCTGGAAACAAGAAACGGTATGTGGTATTTCTACAATAC  
TGATGGTTCAATGGCAATAGGTTGGCTCCAAAACACGGTTTCATGGTACTACCTAAACGCTAACGGCGC  
TATGGCAACAGGTTGGGTGAAAGATGGAGATACCTGGTACTATCTTGAAGCATCAGGTGCTATGAAAGC  
AAGCCAATGGTTCAAAGTATCAGATAAATGGTACTATGTCAACAGCAATGGCGCTATGGCGACAGGCTG  
GCTCCAATACAATGGCTCATGGTACTACCTCAACGCTAATGGTGATATGGCGACAGGATGGCTCCAATA  
CAACGGTTTCATGGTATTACCTCAACGCTAATGGTGATATGGCGACAGGATGGCTAAAGTCAACGGTTTC  
ATGGTACTACCTAAACGCTAACGGTGCTATGGCTACAGGTTGGGCTAAAGTCAACGGTTTCATGGTACTA

Table 1

CCTAAACGCTAACGGTTCAATGGCAACAGGTTGGGTGAAAGATGGAGATACCTGGTACTATCTTGAAGC  
ATCAGGTGCTATGAAAGCAAGCCAATGGTTCAAAGTATCAGATAAATGGTACTATGTCAATGGCTTAGG  
TGCCCTTGCACTAACACAACCTAGATGGCTATAAAGTCAATGCCAATGGTGAATGGGTT

**SP092 amino acid (SEQ ID NO:160)**

TSQPTFVRAEESPOVVEKSSLEKKYEEAKAKADTAKKDYETAKKKAEDAQKKYEDDQKRTEEKARKEAE  
ASQKLNNDVALVQONAYKEYREVQNORSKYSDAEYQKKLTEVDSKIEKARKEQQDLQNKFNVRVAVVP  
EPNALAETKKKAAEEAKAEKVAKRKYDYATLKVALAKKEVEAKELEIEKLQYEISTLEQEVATAQHQVD  
NLKKLLAGADPDDGTEVIEAKLKKGEAELNAKQAEALAKKQTELEKLLDSLDPEGKTQDELDKEAEAEEL  
DKKADELQNKVADLEKEISNLEILLGGADXEDDTAALQNKLATKKAELEKTQKELDAALNELGPDGDEE  
ETPAPAPQPEQPAPAPKPEQPAPAPKPEQPAPAPKPEQPAPAPKPEQPAPAPKPEQPAKPEKPAEEPTQ  
PEKPATPKTGWKQENGWYFYNTDGSMAIGWLQNGSWYYLNANGAMATGWVKDGDWYYLEASGAMKA  
SQWFKVSDKWYYVNSNGAMATGWLQYNGSWYYLNANGDMATGWLQYNGSWYYLNANGDMATGWAKVNGS  
WYYLNANGAMATGWAKVNGSWYYLNANGSMATGWVKDGDWYYLEASGAMKASQWFKVSDKWYYVNLG  
ALAVNTTVDGYKVNANGWV

**P093 nucleotide (SEQ ID NO:161)**

TGGACAGGTGAAAGGTCATGCTACATTTGTGAAATCCATGACAACTGAAATGTACCAAGAACAACAGAA  
CCATTCCTCTCGCCTACAATCAACGCTTGGNTTCGCAAAATCGCATTTGTAGATCCTTTTTTGGCGGAGGG  
ATATGAGGTCAATTACCAAGTGTCTGACGACCCTGATGCAGTCTATGGTTACTTGTCTATTCCAAGTTT  
GGAAATCATGGAGCCGGTTTATTTGGGAGCAGATTATCATCATTTAGGGATGGGCTTGGCTCATGTGGA  
TGGTACACCGCTGCCTCTGGATGGTACAGGGATTTCGCTCAGTGATTGCTGGGCACCGTGCAGAGCCAAG  
CCATGTCTTTTTCCGCCATTGGATCAGCTAAAAGTTGGAGATGCTCTTTATTATGATAATGGCCAGGA  
AATTGTAGAATATCAGATGATGGACACAGAGATTATTTACCGTCGGAATGGGAAAAATTAGAATCGGT  
TAGCTCTAAAAATATCATGACCTTGATAACCTGCGATCCGATTCCTACCTTTAATAAACGCTTATTAGT  
GAATTTTGAACGAGTCGCTGTTTATCAAAAATCAGATCCACAAACAGCTGCAGTTGCGAGGGTTGCTTT  
TACGAAAGAAGGACAATCTGTATCGCGTGTGCAACCTCTCAATGGTTG

**SP093 amino acid (SEQ ID NO:162)**

GQVKGHATFVKSMTTEMYQEQQNHSLAYNQRLXSQNRIVDPFLAEGYEVNYQVSDDPDAVYGYLSIPSL  
EIMEPVYLGADYHHLGMLAHVDGTPPLDGTGIRSVIAGHRAEPSHVFFRHLQDKVGDALYDNGQE  
IVEYQMMDEIILPSEWEKLESVSSKNIMTLITCDPIPTFNKRLLVNFERVAVYQKSDPQTAARVARVAF  
TKEGQSVSRVATSQWL

**SP094 nucleotide (SEQ ID NO:163)**

GATTGCTCCTTTGAAGGATTGAGAGAAACCATGTTGGAATTGCTTCTGGTGCTCAAAATCTTCGTGC  
CAAGGAAGTTGGTGCCTATGAAGTGAAGAGAACTCGCCAATTTAATGCTATGTTGGATCAGATTGA  
TCAGTTGATGGTAGCTATTTCGTAGCCAGGAAGAAACGACCCGTCAGTACCAACTTCAAGCCCTTTTCGAG  
CCAGATTAAATCCACATTTCTCTATAACACTTTGGACACCATCATCTGGATGGCTGAATTTTCATGATAG  
TCAGCGAGTGGTGCAGGTGACCAAGTCCTTGGCAACCTATTTCCGCTTGGCGCTCAATCAAGGCAAGGA  
CTTGATTTGTCTCTCTGACGAAATCAATCATGTCGCCAGTATCTCTTTATCCAGAAACAACGCTATGG  
AGATAAGCTGGAATACGAAATTAATGAAAATGTTGCCCTTTGATAATTTAGTCTTACCCAAGCTGGTCCCT  
ACAACCCCTTGTAGAAAATGCTCTTTACCATGGCATTAAAGGAAAAGGAAGGTGAGGGCCATATTAAGT  
TTCTGTCCAGAAACAGGATTTCGGGATTGGTCATCCGATTGAGGATGATGGCGTTGGCTTCCAAGATGC  
TGGTGATAGTAGTCAAAGTCAACTCAAACGTGGGGAGTTGGTCTTCAAAATGTCGATCAACGGCTCAA  
ACTTCATTTTGGAGCCAATTACCATATGAAGATTGATCTAGACCCCAAAAAGGACGAAAGTTGAAAT  
ATATATAAATAGAACTAGC

**SP094 amino acid (SEQ ID NO:164)**

IAPLKDRLRETMLEIASGAQNLRAKEVGAYELREVTRQFNAMLDQIDQLMVAIRSQEETTRQYQLQALSS  
QINPHFLYNTLDTIIWMAEFHDSQRVVQVTKSLATYFRLALNQKDLICLSDEINHVRQYLFIQKQRYG  
DKLEYEINENVAFDNLVLPKLVLPVENALYHGIKEGQGHKLSVQKQDSGLVIRIEDDGVGFQDA  
GDSSQSQKRGVGLQNVDRQLKLHFGANYHMKIDSRPQKGTKEIYINRIETS

**SP095 nucleotide (SEQ ID NO:165)**

TAGGTCATATGGGACTTTTTTCTACAACAAAATAGGCTCCATAATATCTATAAGGGATTTACCCACTA  
CAAATATTATAGAGCCGAAAATTCACATCTAATATATGCAGACTACTTTGAAATGAAATTAATAAATTT  
ATTAAAGGATGACACAAAAGTTTGTGAAAATCTACATTCAAATTTGTAGAAGGATATAAATATACCT

Table 1

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GACAGAATCTAAAGAATCTGGAATTAAACAAATGGACAATGTCATAAAATATTTTGTAGTTTATTGAATC  
TAAAGTATTGCTTTATATTTTCAAAAACGATTAAATGAGCTGATAGAT

**SP095 amino acid (SEQ ID NO:166)**

RSYGTFFLQONRLHNIYKGFTHYKYRAENSHLIYADYFEMKLKLLKDDTKVFEKSTFKFVEGYKIYL  
TESKESGIKQMDNVIKYFEFIESKSIALYFQKRLNELID

**SP096 nucleotide (SEQ ID NO:167)**

CAACGTTGAGAATTATTTGCGAATGTGTTTGGATAGCATTGAGAATCAGACGTATCAAAATTTTGTAGTG  
TTTATTAAATCAATGATGGCTCTCCAGATCATTCATCCAAAATATGTGAAGAATTTGTAGAGAAAGATTC  
TCGTTTCAAAATATTTTGAAGAAAGCAAACGGCGGTCTTTCATCAGCTCGTAACCTAGGTATTGAATGTTT  
GGGGGGGGCGGTACATTACTTTTGTAGACTC

**SP096 amino acid (SEQ ID NO:168)**

NVENYLRMCLDSIQNTYQNFECCLINDGSPDHSSKICEEFVEKDSRFKYFEKANGGLSSARNLGIECS  
GGGVHYFCRL

**SP097 nucleotide (SEQ ID NO:169)**

CTACTATCAATCAAGTTCTTCAGCCATTGAGGCCACCATTTGAGGGCAACAGCCAAACGACCATCAGCCA  
GACTAGCCACTTTTATTCAGTCTTATATCAAAAACTAGAAACCACCTCGACTGGTTTGACCCAGCAGAC  
GGATGTTTCTGGCCTATGCTGAGAATCCAGTCAAGACAAGGTCGAGGGAATCCGAGATTTGTTTTGAC  
CATCTTGAAGTCAGATAAGGACTTGAAACTGTTGTGCTGGTGACCAAATCTGGTCAGGTCAATTTCTAC  
AGATGACAGTGTGCAGATGAAAACCTCCTCTGATATGATGGCTGAGGATTTGGTACCAAAAGGCCATTCA  
TCAGGGAGCTATGCCTGTTTGTACTCCAGCTCGTAAATCAGATAGTCAGTGGGTCAATTTCTGTCACTCA  
AGAAGTTGTTGATGCAAGGGAGCCAACTCTGGTGTGCTTCGTTTGGATATTTCTTATGAACTCTGGA  
AGCCTATCTCAATCAACTCCAGTTGGGGCAGCAGGGCTTTGCCTTCATTATCAATGAAAACCATGAATT  
TGCTTACCATCCTCAACACACAGTTTATAGTTCTGTCTAGCAAAATGGAGGCTATGAAACCTTACATCGA  
TACAGGTGAGGGTTATACTCCTGGTCACAACTCTACGTCAGTCAAGAGAAGATTGCAGGAACTGATTG  
GACGGTGCTTGGCGTGCATCATTTGAAAAGTTAGACCAGGTTCCGGAGTCAG

**SP097 amino acid (SEQ ID NO:170)**

YYQSSSAIEATIEGNSQTTISQTSHFQSYIKKLETTSTGLTQOTDVLAYENPSQDKVEGIRDLFLLT  
ILKSDKDLKTVVLVTKSGQVISTDDSVQMKTSDDMAEDWYQKAIHQGAMPVLTTPARKSDSQWVISVTQ  
ELVDAKGANLGVRLDISYETLEAYLNQLQLGQQGFAFIINENHEFVYHPQHTVYSSSSKMEAMKPYID  
TGQGYTPGHKSYVSQEKIAGTDWTVLGVSSLEKLDQVRSQ

**SP098 nucleotide (SEQ ID NO:171)**

GACAAAAACATTAAACGTCCTGAGGTTTATCACCTGCAGGGACTTTAGAGAAGCTAAAGGTAGCTGT  
TCAGTATGGAGCAGATGCTGTCTTTATCGGTGGTCAGGCCTATGGTCTTCGTAGCCGTGCGGGAACCTT  
TACTTTTGAACAGATGGAAGAAGGCGTGCAGTTTGGCGCAAGTATGGTGCCAAGGTCTATGTAGCGGC  
TAATATGGTTATGCACGAAGGAAATGAAGCTGGTGCTGGTGAGTGGTTCGGTAAACTGCGTGATATCGG  
GATTGCAGCAGTTATCGTATCTGACCCAGCCTTGATTATGATTGCAGTGACTGAAGCACCAGGCCCTTGA  
AATCCACCTTTCTACCAAGCCAGTGCCACTAACTATGAAACCTTGAGTTCTGGAAAGAGCTAGGCTT  
GACTCGTGCTGTTTATGCGCGTGAGGTTTCAATGGAAGAATTAGCTGAGATCCGCAACGTCACAGATGT  
TGAAATTGAAGCCTTTGTCCATGGAGCTATGTGTATTTCACTCTGGACGTTGTACTCTTTCAAACCA  
CATGAGTATGCGTGATGCCAACCGTGGTGGATGTTCTCAGTCATGCCGTTGGAATACGACCTTTACGA  
TATGCCATTTGGGAAGAAGCTAAGAGTTTGACGGGTGAGATTCAGAGAATTTTCAATGTCAGCCGT  
TGACATGTCTATGATTGACCANATTCAGATATGATTGAAAATGGTGTGGACAGTCTAAAAATCGAAGG  
ACGTATGNAGTCTATTCATTANGTATCAACAGTAACCAACTGCTACAAGCGGCTGTGGATGCCATCT  
TGAAAGTCCTGAAAAGTTTGAAGCTATCAAAACAAGACTTGGTGGACGAGATGTGGAAGGTTGCCAACG  
TGAAGTGGCTACAGGATTTTACTATGGTACACCATCTGAAAATGAGCAGTTGTTTGGTGCTCGTCGTAA  
AATCCCTGAGTACAAGTTTGTGCTGAAAGTGGTTTCTTATGATGATGCGGACAAACAGCAACTATTG  
TCAACGAAACGTCATTAAACGAAGGGGACCAAGTTGAGTTTATGGTCCAGGTTTCCGTCATTTTGAAC  
CTATATTGAAGATTTGCATGATGCTAAAGGCAATAAAATCGACCGCGCTCCAAATCCAATGGAAGTATT  
GACTATTAAAGTCCCAACCTGTTCAATCAGGAGACATGGTTCGAGCTCTTAAAGAGGGGCTTATCAA  
TCTTTATAAGGAAGATGGAACCGCTCACAGTTCGTGCT

Table 1

**SP098 amino acid (SEQ ID NO:172)**

TKTLKRPEVLSPAGTLEKLKQVAVQYGAQVIGGQAYGLRSRAGNFTFEQMEEGVQFAAKYGAQVYVAA  
NMVMHEGNEAGAGGEWFRKLRLDIGIAAVIVSDPALIMIAVTEAPGLEIHLSTQASATNYETLEFWKELGL  
TRVVLAREVSMEELEIRKRTDVEIEAFVHGAMCISYSGRCTLNHNMSMRDANRGGCSQSCRWKYDLYD  
MPFGKERKSLQGEIPEEFMSAVDMSMIDXIPDMIENGVDLSKIEGRMXSIHXVSTVTNCKYAAVDAYL  
ESPEKFEAIKQDLVDEMVKVAQRELATGFYYGTPSENEQLFGARRKIPEYKFVAEVVSYDDAAQTATIR  
QRNVINEGDQVEFYGPGRHFFETYIEDLHDAKGNKIDRAPNPMELLTIKVPQPVQSGDMVRALKEGLIN  
LYKEDGTSVTVRA

**SP099 nucleotide (SEQ ID NO:173)**

TTCTCAGGAGACCTTTAAAAATATCACCAATAGCTTCTCCATGCAAATCAATCGTCGCGTCAACCAAGG  
AACGCCCTCGTGGTGTCTGGGAATATCAAGGGTGAAGACATCAAAAAATCACCGAAAAACAAGGCCATTGA  
GTCTTATGTCAAACGTATCAACGCTATCGGAGATTTGACTGGATATGACCTGATTGAAACGCCAGAAAC  
CAAGAAGAATCTCACTGCTGATCGTGCCAAAGCGTTTGGAAAGTAGCTTGTATGATTACAGGTGTCAATGA  
CTCTCTTAAAGAAGACAAGTTTGTCTCTGTTCTTATAAACTAGTCGAAGGAGAGCACTTAACCAACGA  
CGACAAGGATAAAAAATCTCTTGCACAAGGACTTGGCAGCCAAACACGGCTGGAAAGTAGGGGACAAGGT  
TAACTGGACTCTAATATCTACGATGCAGATAATGAAAAAGGAGCCAAGGAAACAGTTGAAGTGACAAT  
CAAGGGACTCTTTGATGGTCATAATAAGTCAGCAGTAACCTACTCACAAGAACTTTACGAAAAACACAGC  
TATTACAGACATTCACACTGCTGCAAACTTTATGGATACACAGAAGACACAGCCATTTATGGGGACGC  
AACCTTCTTTGTAACAGCAGACAAGAACTTGGATGATGTTATGAAAGAGTTGAATGGCATCAGTGGTAT  
CAACTGGAAGAGCTACACACTCGTCAAGAGCTCCTCTAACTACCCAGCTCTTGAGCAATCTATCTCTGG  
TATGTACAAGATGGCCAAC

**SP099 amino acid (SEQ ID NO:174)**

SQETFKNITNSFSMQINRRVNQGTGPRGAGNIKGEDIKKITTENKAIESYVKRINAIGDLTGVDLIETPET  
KKNLTADRKRFGSSLMITGVNDSSKEDKVFSGSYKLVEGEHLTNDKDKILLHKDLAAKHGKVGDKV  
KLDSNIYDADNEKGAKETVEVTIKGLFDGHNKSAVTYSQELYENTAIDITHAAKLYGYTEDTAIYGDA  
TFFVTADKNLDDVMKELNGISGINWKSYSYTLVKSSSNYPALQSIISGMYKMAN

**SP100 nucleotide (SEQ ID NO:175)**

AGTAAATGCGCAATCAAATTCATTAATATTAATAGATGAACCTGAAATCTCACTTCATCCGAGTGCAAT  
CTATAAATTTAAAGAGTTTACTTCAAGAGTGTTTAAATAAAAAACATCAAATTATATCACTACACA  
TTCTACACAACCTTATAAAGATTTCCTAGAGAAGCCGTGAAACTTTTAGTGAAAAACGGAGAAAAGGT  
AGATGTTATTGAAAAATATTGATTATCAGGATGCATTTTTTGAATTAGGTGATGTGTATCATTCTAGGAA  
GATGATTTATGTTGAAGATAGACTAGCTAAATATATTCTAGAGTTTGTATCACTCATTTCAGGTAGTGA  
GAATCTTAAACAGAATTTAGTAGTGAGATATATTCTGGTGGAGCAAATCAAATAATTTGTAATAATAT  
TTTAAACTCATCGTATTTAGATTCGGATAACCATTATTTTTGGCTTGATGGAGATCAAAACACTAATGT  
TAGTGAATCAAATAATTTAATGAACATCTTGAAAAATGGTGTGTTATATCAGATAAAATTCCTGAATC  
AGATAATAAAAAATCTTGATGATATTATAAAATTGATAANGGGATGTCCAATTAATTTAATGTTTCAGG  
TAATAAAGGGCAAAAAATAATATTGAATTAATTGCGAAACAAAGAAGCTTTATAGATTATTGGGCTAA  
ATAC

**SP100 amino acid (SEQ ID NO:176)**

VNAQSNLSLILIDEPEISLHPSAIYKFKEFLQECNLNKKHQIITTHSTQLIKDFPREAVKLLVKNGEKV  
DVNIENIDYQDAFFELGDVYHSRKMIYVEDRLAKYILEFVITHSGSENKQNLVVRYPGGANQIICNNI  
LNSSYLSDSNHYFWLDGDQNTNVSESNNLMNYLENGVVISDKIPESDNKNLDDIIKLIXGCPKFNVS  
G

**SP101 nucleotide (SEQ ID NO:177)**

TTACCGCGTTTCATCAAGATGTCAAACAAGTCATGACCTATCAACCCATGGTGGCAGAAATATTGAGTGA  
ACAAGACACCCCAAGCAAAACGAAGAGCTTGTGCTTGCTATGATTTATACTGAAACAAAAGGAAAAGAAGG  
CGATGTTATGCAGTCTAGTGAGTCTGCAAGTGGTCCACCAACACCATCAATGATAATGCCCTCTAGCAT  
TCGGCAAGGCATTCAAACCTGACAGGCAATCTCTATCTGGCGCAGAAGAAGGGGGTAGATATCTGGAC  
AGCTGTTCAAGCCTATAATTTGGACCTGCCTATATCGATTTTATCGCCCAAAATGGCAAGGAAAATAC  
CCTGGCTCTAGCCAAACAGTACTCTCGTGAGACTGTTGCCCCCTTGCTTGGTAATAGGACTGGAAGAC  
TTATAGTTATATTCACCCCATTTCCATTTTTCACGGTGTGAACTCTATGTAATGGAGGAACTATTAT  
TTATCTAGACAGGTACGACTTAACCTTTACATCATCAATGTTTCACTCTCTTTTCAACATCTGGC

Table 1

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## SP101 amino acid (SEQ ID NO:178)

YRVHQDVQVMTYQPMVREILSEQDTPANEELVLAMIYTTETKGKEGDMQSSSESASGSTNTINDNASSI  
RQGIQTLTGNLYLAQKKGVDIWTAQAYNFGPAYIDFIAQNGKENTLALAKQYSRETVAPLLGNRTGKT  
YSYIHPISIFHGAELYVNGGNYYSRQVRLNLYIICKFTLFSTSG

## SP102 nucleotide (SEQ ID NO:179)

GTGGATGGGCTTTAACTATCTTCGTATTGCGCGTGGCGCTAAAAATTGTGGACAATGAGGAGTTTGAAGC  
CTTGATTCTGACGGGTCAATTGATTGATTGCGCGACCCAGCAGAATCCACAGAAAACATATCCTTGG  
TGCACGCAATATTCCTTCAAGTCAGTTGAAAAGTAGTCTTGACGCCCTTCGTAAGATAAACCTGTCCCT  
TCTTACGAAAACCAACGTGCGCAACGAGTTACAAATGCAGCTCTTTACTTGAAAAACAAGGTTTTTC  
TGAGATTTATATCCTTTCTTATGGCTTGAGTTCTTGGAAGGGAAGTGAAGACTAGC

## SP102 amino acid (SEQ ID NO:180)

WMGFNYLRIRRAAKIVDNEEFALIRTGQLIDLDPAEFHRKHILGARNIPSSQLKTSLAALRKDKPVL  
LYENQRAQRTNAALYLKKQGFSEIYILSYGLDSWKGKVKTS

## SP103 nucleotide (SEQ ID NO:181)

ACTAAACCAGCATCGTTCGAGGAAAAATAAGGACAATAATCGTGTCTCTTATGTGGATGGCAGCCAGTC  
AAGTCAGAAAAGTGAAAACCTTGACACCAGACCAGGTTAGCCAGAAAAGAAGGAATTCAGGCTGAGCAAA  
TGTAATCAAAATTACAGATCAGGGCTATGTAACGTACACCGGTGACCACTATCATTACTATAATGGGAA  
AGTTCCTTATGATGCCCTCTTTAGTGAAGAACTCTTGATGAAGGATCCAAACTATCAACTTAAAGACGC  
TGATATTGTCAATGAAGTCAAGGGTGGTTATATCATCAAGGTCGATGGAAAATATTATGTCTACCTGAA  
AGATGCAGCTCATGCTGATAATGTTTGAAGTAAAGATGAAATCAATCGTCAAAAACAAGAACATGTCAA  
AGATAATGAGAAGGTTAACTCTAATGTTGCTGTAGCAAGGTCCTCAGGGACGATATACGACAAATGATGG  
TTATGTCTTTAATCCAGCTGATATTATCGAAGATACGGGTAATGCTTATATCGTTCTCATGGAGGTCA  
CTATCACTACATTCCCAAAAGCGATTTATCTGCTAGTGAATTAGCAGCAGCTAAAGCACATCTGGCTGG  
AAAAAATATGCAACCGAGTCAGTTAAGCTATTCTTCAACAGCTAGTGACAATAACACGCAATCTGTAGC  
AAAAGGATCAACTAGCAAGCCAGCAATAAATCTGAAAACTCCAGAGTCTTTTGAAGGAAGCTCTATGA  
TTCACCTAGCGCCCAACGTTACAGTGAATCAGATGGCCTGGTCTTTGACCTGCTAAGATTATCAGTCG  
TACACCAAAATGGAGTTGCGATTCCGCAATGGCGACCAATTACCACTTTATTCTTACAGCAAGCTTTCTGC  
CTTAGAAGAAAAGATTGCCAGAAATGGTGCCATCAGTGGAACTGGTTCTACAGTTTCTACAAATGCAAA  
ACCTAATGAAGTAGTGTCTAGTCTAGGCAGTCTTTCAAGCAATCCTTCTCTTTAAGCAAGTAAGGA  
GCTCTCTTACAGATCTGATGGTTATATTTTAAATCCAAAAGATATCGTTGAAGAAACGGCTACAGCTTA  
TATTGTAAGACATGGTGATCATTTCCATTACATTTCAAAATCAAAATCAAAATGGGCAACCGACTCTTCC  
AAACAATAGTCTAGCAACACCTCTCCATCTCTTCAATCAATCCAGGAACCTTACATGAGAAACATGA  
AGAAGATGGATACGGATTGATGCTAATCGTATTATCGTGAAGATGAATCAGGTTTTGTCTAGTCA  
CGGAGACCACAATCATTATTTCTTCAAGAAG

## SP103 amino acid (SEQ ID NO:182)

LNQHRSEQENKDNVRVSYVDGSQSSQKSENLTDPQVSQKEGIAEQIVIKITDQGYVTSHGDHYHYNYNGK  
VPYDALFSEELMKDPNYQLKDADIVNEVKGGYIIKVDGKYYVYLKDAHADNVRTKDEINRQKQEHVK  
DNEKVNINAVARSQGRYTTNDG/VFNPADIIEDTGNAYIVPHGGHYHYIPKSDLASELAAAKAHLA  
KMQPSQLSYSSASDNNQSVAGSTSKPANKSENLSLLKELYDSPSAQRYSESGLVFPDAKIIISR  
TPNGVAIPHGDHYHFIPYSKLSALEEKIARMVPISGTGSTVSTNAKPNEVSSLSLSSNPSSLTTSKE  
LSSASDGYIFNPKDIVEETATAYIVRHGDHFFHYIPKSNQIQPTLPNNSLATPSPSLPINPGTSHEKHE  
EDGYGFDANRIIAEDESFGVMSHGDHNYFFKK

## SP105 nucleotide (SEQ ID NO:183)

TGACTACCTTGAAATCCCACTTTACAGCTATCTTGGTGGATTCAACACTAAAGTTCTTCCAACTCCAAT  
GATGAACATCATCAACGGTGGTTCTCACTCTGACGCTCCAATCGCTTTCCAAGAGTTTCATGATCTTGCC  
AGTTGGTGCGCCAACATTTAAAGAAGCCCTTCGTTACGGTGCTGAAATCTTCCACGCTCTTAAGAAAAT  
CCTTAAATCACGTGGTTTGGAACTGCCGTAGGTGACGAAGGTGGATTTCGCTCTCGTTTCGAAGGAAC  
TGAAGATGGTGTTGAAACTATCCTTGCTGCGATTGAAGCTGCTGGATATGTACCAGGTAAAGACGTATT  
TATCGGATTTGACTGTGCTTCATCAGAATCTACGATAAAGAACGTAAAGTTTACGACTACACTAAATT  
TGAAGGTGAAGGTGCTGCTGTTCTGATACATCTGCAGAACAAATCGACTACCTTGAAGAAATGGTTAACAA  
ATACCAATCATCACTATTGAAGATGGTATGGATGAAAACGACTGGGATGGTTGGAAAGCTCTTACTGA  
ACGCTCTGGTAAGAAAGTACAACCTGTTGGTGACGACTTCTTCGTAACAAACACTGACTACCTTGACAG

Table 1

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TTGGTATCCAAGAAGGTGCTGCTAACTCAATCCTTATCAAAGTTAACCAATCGGTACTCTTACTGAAAC  
TTTTGAAGCTATCGAAATGGCTAAAGAAGCTGGTTACACTGCTGTTGTATCACACCGTTCAGGTGAAAC  
TGAAGATTCAACAATCGCTGATATTGCAGTTGCAACTAACGCAGGACAAATCAAGACTGGTTCACCTTC  
ACGTACAGACCGCATCGCTAAATACAACCAATTGCTTCGTATCGAAGACCAACTTGGTGAAGTAGCTGA  
ATATCGTGGATTGAAATCATTCTACAACCTTAAAAAA

**SP105 amino acid (SEQ ID NO:184)**

DYLEIPLYSYLGGFNTKVLPTPMNIINGGSHSDAPIAFQEFMILPVGAPTFKEALRYGAEIFFHALKKI  
LKSRGLETAVGDEGGFAPRFEGTEDGVETILAAIEAAGYVPGKDVFIGFDCASSEFYDKERKVYDYTKF  
EGEGAAVRTSAEQIDYLEELVNKYPIITIEDGMDENDWDGWKALTERLGKKVQLVGDDFFVTNTDYLAR  
GIQEGAANSILIKVNQIGTLTETFEAIEAKEAGYTAVVSHRSGETEDSTIADIAVATNAGQIKTGSLS  
RTDRIAKYNQLLRIEDQLGEVAEYRGLKSFYNLKK

**SP106 nucleotide (SEQ ID NO:185)**

TCGTATCTTTTTTGGAGCAATGTTCCGCTAGAAGGACATTCCATGGATCCGACCCTAGCGGATGGCGA  
AATTCTCTCTGTTGTAACACCTTCCTATTGACCGTTTGGATATCGTGGTGGCCCATGAGGAAGATGG  
CAATAAGGACATCGTCAAGCGCGTGATTGGAATGCCTGGCGACACCATTCGTTACGAAAATGATAAACT  
CTACATCAATGACAAAGAAACGGACGAGCCTTATCTAGCAGACTATATCAAACGCTTCAAGGATGACAA  
ACTCCAAAGCACTTACTCAGGCAAGGGCTTTGAAGGAAATAAAGGAACCTTCTTTAGAAAGTATCGCTCA  
AAAAGCTCAAGCCTTACAGTTGATGTCAACTACAAACCAACTTTAGCTTTACTGTTCCAGAAGGAGA  
ATACCTTCTCCTCGGAGATGACCGCTTGGTTTCGAGCGACAGCCGCCACGTAGGTACCTTCAAAGCAAA  
AGATATCACAGGGGAAGCTAAATTCGCTTATGGCCAATCACCCGTATCGGAACATTT

**SP106 amino acid (SEQ ID NO:186)**

RIFFWSNVREGHSMPTLADGEILFVVKHLPIDRFDIVVAHEEDGNKDIVKRVIGMPGDTIRYENDKL  
YINDKETDEPYLADYIKRFKDDKLQSTYSKGFEKNKGTFFRSIAQKAQFTVDVNYNTNFSFTVPEGE  
YLLGLDDRLVSSDSRHVGTFFAKDITGEAKFRLWPITRIGTF

**SP107 nucleotide (SEQ ID NO:187)**

GGACTCTCTCAAAGATGTGAAAGCAAATGCTAGCGACAGCAAGCCTGCACAGGACAAGAAGGATGCAAA  
ACAAGGAACGGAAGATAGTAAGGATTCAGATAAGATGACTGAAACAAACTCAGTTCCGGCAGGAGTGAT  
TGTGGTCAGTCTACTTGGCCCTCCTAGGCGTGATTGCCTTCTGGCTGATTGCGCGTAAGAAAGAGTCAGA  
AATCCAGCAATTAAGCACGGAATTGATCAAGGTTCTAGGACAGCTAGATGCAGAAAAAGCGGATAAAAA  
AGTCCTTGCCAAAGCCCAAAACCTTCTCCAAGAAACCTTGATTTCTGTAAGAGAAGAAAAATGGCTCAGC  
AGAGACAGAAACTAAACTAGTAGAGGAGCTTAAAGCAATCCTTGACAAACTCAAG

**SP107 amino acid (SEQ ID NO:188)**

DSLKDVKANASDSKPAQDKDAKQGTEDSKSDKMTETNSVPAGVIVVSLALLGVIAFWLIRPKKESE  
IQQLSTELIKVLGQLDAEKADKKVLAKAQNLLQETLDFVKEENGSAETETKLVEELKAILDKLK

**SP108 nucleotide (SEQ ID NO:189)**

CAAGAAATCCTATCATCTCTTCCAGAAGCAAACAGAGACGAGGGGAATTCAGACTCAGTTGATTGAAGA  
ATCGCTTAGTCAGCAGACTATAATCCAGTCCTTCAATGCTCAAACAGAAATTTATCCAAAGATTGCGTGA  
GGCTCATGACAACACTCTCAGGCTATTCTCAGTCAGCCATCTTTTATTCTTCAACGGTCAATCCTTCGAC  
TCGCTTTGTAATGCACCTATTTATGCCCTTTTAGCTGGAGTAGGAGCTTATCGTATCATGATGGGTTC  
AGCCTTGACCGTCGGTCGTTTAGTGACTTTTTTGAAGTATGTTTCAGCAATACACCAAGCCCTTTAACGA  
TATTTCTTCAGTGCTAGCTGAGTTGCAAAGTGCTCTGGCTTGCGTAGAGCGTATCTATGGAGTCTTAGA  
TAGCCCTGAAGTGGCTGAAACAGGTAAGGAAGTCTTGACGACCACTGACCAAGTTAAGGGAGCTATTTTC  
CTTTAAACATGTCTCTTTGGCTACCATCCTGAAAAAATTTTGATTAAGGACTTGTCTATCGATATTTCC  
AGCTGGTAGTAAGGTAGCCATCGTTGGTCCGACAGGTGCTGGAAAAATCAACTCTTATCAATCTCCTTAT  
GCGTTTTTATCCCATAGCTCGGGAGATATCTTGCTGGATGGGCAATCCATTTATGATTATACACGAGT  
ATCATTTGAGACAGCAGTTTGGTATGGTGCTTCAAGAAACCTGGCTCACACAAGGGACCATTCATGATAA  
TATTGCTTTTGGCAAATCCTGAAGCCAGTCGAGAGCAAGTAATTGCTGCTGCCAAAGCAGCTAATGCAGA  
CTTTTTCATCCAACAGTTGCCACAGGGATACGATACCAAGTTGGAAAAATGCTGGAGAATCTCTCTCTGT  
CGGCCAAGCTCAGCTCTTGACCATAGCCCGAGTCTTTCTGGCTATTCCAAAGATTCTTATCTTAGACGA  
GGCAACTTCTTCCATTGATACACGGACAGAAAGTGCTGGTACAGGATGCCTTTGCAAAACTCATGAAGGG  
CCGCACAAGTTTCATCATTGCTCACCGTTTGTCAACCATTCAGGATGCGGATTTAATTCTTGTCTTAGT



Table 1

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AGATGGTGATATTGTTGAATATGGTAACCATCAAGAACTCATGGATAGAAAGGTAAGTATTACCAAAT  
GCAAAAAGCTGCGGCTTTTAGTTCTGA

A

**SP108 amino acid (SEQ ID NO:190)**

KKSYHLFQQTETRGITQQLIEESLSQQTIIQSFNAQTEFIQRLREAHNDNYSQSAIFYSSSTVNPST  
RFVNALIYALLAGVGAYRIMMGSALTIVGRLVTFNLNVQYTKPFNDISSVLAELQSALACVERIYGVLD  
SPEVAETGKEVLTTSDQVKGAISFKHVSFGYHPEKILIKDLSIDI PAGSKVAIVGPTGAGKSTLINLLM  
RFYPISSGDIILLDGQSIYDYTRVSLRQQFGMVLQETWLTQGTIHDNIAFGNPEASREQVIAAKAANAD  
FFIQQLPQGYDTKLENAGESLSVGQAQLLTIARVFLAIPKILILDEATSSIDTRTEVLVQDAFAKLMKG  
RTSFIIAHLSTIQDADLILVLVDGDIVVEYGNHQELMDRKGKYYQMKAASFSE

**SP109 nucleotide (SEQ ID NO:191)**

ACGAAATGCAGGGCAGACAGATGCCTCGCAAATTGAAAAGGCGGCAGTTAGCCAAGGAGGAAAAGCAGT  
GAAAAAACAGAAATTAGTAAAGACGCAGACTTGACAGAAATTTATCTAGCTGGAGGTTGTTTCTGGGG  
AGTGGAGGAATATTTCTCACGTGTTCCCGGGGTGACGGATGCCGTTTTCAGGCTATGCAAAATGGTAGAGG  
AGAAACAACCAAGTACGAATTGATTAACCAACAGGTCATGCAGAAACCGTCCATGTCACCTATGATGC  
CAAGCAAATTTCTCTCAAGGAAATCCTGCTTCACTATTTCCGCATTATCAATCCAACAGCAAAAAATAA  
ACAAGGAAATGATGTGGGGACCCAGTACCGTACTGGTGTATTATACACAGATGACAAGGATTTGGAAGT  
GATTAACCAAGTCTTTGATGAGGTGGCTAAGAAATACGATCAACCTCTAGCAGTTGAAAAGGAAAACCTT  
GAAGAATTTTGTGGTGGCTGAGGATTACCATCAAGACTATCTCAAGAAAAATCCAAATGGCTACTGCCA  
TATCAATGTTAATCAGGCGGCCTATCCTGTCATTGATGCCAGCAATATCCAAAACCAAGTATGAGGA  
ATTGAAAAAGACCCCTGTCACCTGAGGAGTATGCAGTTACCCAGGAAAAATCAACAGAACGAGCTTTCTC  
AAACCGTTACTGGGATAAAATTTGAATCCGGTATCTATGTGGATATAGCAACTGGGGAACCTCTCTTTTC  
ATCAAAAGACAAATTTGAGTCTGGTGTGGCTGGCCTAGTTTACCCAACCCATCAGTCCAGATGTTGT  
CACCTACAAGGAAGATAAGTCTTACAATATGACGCGTATGGAAGTGCGGAGCCGAGTAGGAGATTCTCA  
CCTTGGGCATGTCTTTACGGATGGTCCACAGGACAAGGGCGGCTTACGTTACTGTATCAATAGCCTCTC  
TATCCGCTTTATTCCCAAAGACCAATGGAAGAAAAAGGCTACGCTTATTTACTAGATTATGTTGAT

**SP109 amino acid (SEQ ID NO:192)**

RNAGQTDASQIEKAASVQGGKAVKKTEISKDADLHEIYLAGGCFWGVVEYFSRVPVGTDAVSGYANGRG  
ETTKVELINQTHAETVHVYDQKQISLKEILLHYFRIINPTSKNKQGNVDVGTQYRTGVVYTDKDLV  
INQVDEVAKKYDQPLAVEKENLKNFVVAEDYHQDYLLKNPNGYCHINVNQAAYPVIDASKYKPSDEE  
LKKTLSPPEYAVTQENQTERAFSNRYWDFESGIYVDIATGEPLFSSKDKFESGCGWPSFTQPI SPDVV  
TYKEDKSYNMRMEVRSRVGDSHLGHVFTDGPQDKGLRYCINSLIRFIPKQMEEEKGYAYLLDYVD

**SP110 nucleotide (SEQ ID NO:193)**

TGTATAGTTTTAGCGCTTGTTCTTCTAATTCTGNATAAAATGAAGAAAATACTTCTAAAGAGCATGCG  
CCTGATAAAATAGTTTTAGATCATGCTTTCCGGTCAAACCTATATTAGATAAAAAACCTGAAAGAGTTGCA  
ACTATTGCTTGGGGAAATCATGATGTAGCATTAGCTTTAGGAATAGTTCCTGTTGGATTTTCAAAGCA  
AATTACGGTGTAAGTGCTGATAAAGGAGTTTACCATGGACAGAAGAAAAATCAAAGAACTAAATGGT  
AAAGCTAACCTATTTGACGATTTGGATGGACTTAACCTTTGAAGCAATATCAAATTTCTAAACCATGTT  
ATCTTAGCAGGTTATTCTGGTATAACTAAAGAAGATTATGACACTCTATCA

**SP110 amino acid (SEQ ID NO:194)**

CIVFSACSSNSXKNEENTSKEHAPDKIVLDHAFGQTILDKKPERVATIAWGNHDVALGIVPVGFASKA  
NYGVSADKGVLPWTEEKIKELNGKANLFDLGLNFEAISNSKPDVILAGYSGITKEDYDTLS

**SP111 nucleotide (SEQ ID NO:195)**

GTGTGTCGAGCATATTCTGAAGCAAACCTATCAAAATATAGAAATTATTTAGTTGATGACGGTTCTAC  
GGATAATTCTGGGGAAATTTGTGATGCTTTTATGATGCAAGATAATCGTGTGCGAGTATTGCATCAAGA  
AAATAAGGGGGGGGAGCACAAGCTAAAAATATGGGGATTAGTGTAGCTAAGGAGAGTACATCACGAT  
TGTTGATTCAGATGATATCGTAAAAAGAAAATATGATTGAAACTCTTTATCAGCAAGTCCAAGAAAAGGA  
TGCAGATGTTGTTATAGGGAATTACTATAATTATGACGAAAGTGACGGGAATTTTATTTTATGTAAC  
AGGGCAAGATTTTTCGCTCGAAGAATTAGCTATACAAGAAATTATGAACCGTCAAGCAGGAGATTGGAA  
ATTCAATAGCTCGGCTTTTATATTGCCGACATTTAAGTTGATTAAAAAAGAATTATTCAATGAAGTTCA  
CTTTTCAAATGGTCGCGCTTTGATGATGAAGCAACTATGCATCGCTTTTATCTTTTAGCCTCTAAAT  
CGTCTTTTATAAACGATAATCTCTATCTGTATAGAAGACGTTTACGGAAGCATCATGAGAACGGAATTGGA

Table 1

TCTTTCTGGGCAAGAGATATTGTTGAAGTGTCTTCTAAGAAAATATCGGATTGTGTCTTGGCTGGTTT  
GGATGTCTCCGTCTGCGTATTGCAATCTTTAAAAGATTATAAGCAAACCTTTAGAATACCA  
TCAATTAACAGATACTGAGGAATATAAGATATTTGTTTCAGATTAAAGTTGTTTTTGTATGCAGAACA  
AAGAAATGGTAAAGT

**SP111 amino acid (SEQ ID NO:196)**

CVEHILKQTYQNIIEILVDDGSTDNSGEICDAFMMQDNVRVLHQENKGGAAQAKNMGISVAKGEYITI  
VSDDDIVKENMIETLYQQVQEKDADVIGNYNYDESNGFYFYVTGQDFCVELAIQEIIMNRQAGDWK  
FNSSAFILPTFKLIKKELFNEVHF SNGRRFDDEATMHRFYLLASKIVF INDNLVLYRRRSGS IMRTEFD  
LSWARDIVEVFSKKISDCVLAGLDVSVLRIRFVNLLKDYKQ TLEYHQLTDTEEYKDICFRLKLFDAEQ  
RNGKS

**SP0112 nucleotide (SEQ ID NO:197)**

GTGTTTGGATAGCATTGAGAAATCAGACGTATCAAAATTTTGGAGTGTATTATTAATCAATGATGGCTCTCC  
AGATCATTCATCCAAATATGTGAAGAATTGTAGAGAAAGATTCTCGTTTCAAATATTTTGAAGAACG  
AAACGGCGGTCTTTCATCAGCTCGTAACCTAGGTATTGAATGTTCCGGGGGGGGCGTACATTACTTTTGT  
AGACTCTGATGATTGGTTGGAACATGATGCTTTAGACCGATTATATGGTGCTTTGAAAAAGGAAAAACGC  
AGATATTAGTATCGGGCGTTATAATCTTATGATGAAACACGCTATGTGTATATGACTTATGTTACGGA  
TCCAGATGATTCTCTAGAAGTGAAGAAGTAAAGCAATTATGGATAGGGAAGGTGTCGAAGAAGTCAG  
AAATGGGAACCTGGACTGTGCTGTTGAAGTTATTCAAGAGAGAGTTACTACAAGATTTACCATTTC  
TATAGGAAAAATTGCAGAGGATACTTACTGGACATGGAAGGTACTTCTAAGAGCTTCGAGGATAGTCTA  
TTTGAATCGTTGTGTTTACTGGTACCGTGTGGTTTATCTGATCTTTATCGAATACATGGAGTGAAAA  
GCGTATGTATGATGAAATTGGGGCTAGGGAAGAAAAGATAGCTATTTTAGCAAGTTCAGACTATGACTT  
GACCAATCATATTTTGAATTATAAAAATAGATTACAAAGAGTGATAGCAAAATTAGAAGAACAAAATAT  
CGAGTTCACAGAGATTACAGAAGAATGATGGAAAAATTGCTTTACTTCCG

**SP0112 amino acid (SEQ ID NO:198)**

CLDSIQNQTYQNFECILLINDGSPDHSSKICEFVEKDSRFKYFEKANGGLSSARNLGIIECSGGAYITFV  
DSDDWLEHDALDRLYGALKKENADISIGRYNSYDETRVYMYTVTDPPDSLEVIEGKAIMDREGVEEVR  
NGNWTVAVLKLFKRELLQDLFPPIGKIAEDTYWTKVLLRASRIVYLNRCVYWRVGLSDTLSTWSEK  
RMYDEIGAREEKIAILASSDYDLTNHILYKNRLQRVIAKLEEQNMQFTEIYRRMEKLSLLP

**SP113 nucleotide (SEQ ID NO:199)**

GTGCC TAGATAGTATTATTACTCAAACATATAAAAATATTGAGATTGTTGTCGTTAATGATGGTTCTAC  
GGATGCTTCCAGGTGAAATTTGTAAAGAATTTTCAGAAATGGATCACC GAATTCCTATATAGAACAAGA  
AAATGCTGGTCTTTCTGCCGCACGAAACACCGGTCTGAATAATATGTCCGAAATTTATGTGACCTTTGT  
GGACTCGGATGATTGGATTGAGCAAGATTATGTAGAACTCTATATAAAAAAATAGTAGAGTATCAGGC  
TGATATTGCAGTTGGTAATTATTCTTTCAACGAAAGTGAAGGAATGTTCTACTTTCATATATTGGG  
AGACTCCTATTATGAGAAAGTATATGATAATGTTTCTATCTTTGAGAACTTGATGAAACTCAAGAAAT  
GAAGAGTTTTGCTTTGATATCTGCTTGGGGTAAACTCTATAAGGCAAGATTGTTTGGAGCAGTTGCGCTT  
TGACATAGGTAAATTAGGAGAAGATGGTTACCTCAATCAAAAGGTATATTTATTATCAGAAAAGGTAAT  
TTATTTAAATAAAAGTCTTTATGCTTATCGGATTAGAAAAGGTAGTTTATCAAGAGTTTGGACAGAAAA  
GTGGATGCACGCTTTAGTTGATGCTATGTCTGAACGTATTACGCTACTAGCTAATATGGGTTATCCTCT  
AGAGAAACACTTGGCAGTTTATCGTCAGATGTTGGAAGTCAGTCTCGCCAACGGTCAAGCTAGTGGTTT  
ATCTGACACAGCAACGTATAAAGAGTTTGAAATGAAACAAAGGCTTTTAAATCAGCTATCGAGACAAGA  
GGAAAGTGAAAAAGAAAGCCATTGTCTCGCAGCAAACTATGGCTATGTAGACCAAGTTTAAACGCAAT  
CAAGTCTATTTGTTATCATAATCGTTCCGATTGCTTTTATCTGATTATAGCGATTTTCCAAATGAATG  
GATTAAGCAATTAATAAGCGCTTAGAGAAGTTTGACTCAGAAATTAATTAATTGTCGGGTAACCTTCTGA  
GCAAAATTTCAATGTTTATAAATCGGATATTAGTTACACAGTCTTTTACGCTATTTTATAGCTGATTTCTGT  
GCAAGAAGACAAGGCCCTCTACTTGGACTGTGATCTAGTTGTAACGAAAAATCTGGATGACTTGTGTTGC  
TACAGACTTACAAGATTATCCTTTGGCTGCTGTTAGAGATTTTGGGGGCAGAGCTTATTTTGGTCAAGA  
AATCTTTTAAATGCCGGTGTCTCTTGGTAAACAATGCTTTTGGAAAAAAGAGAATATGACCCAAAAAT  
AATTGATGTAACCAATGAATGGCATGATAAGGTGGATCAGGCAGATCAGAGCATCTTGAATATGCTTTT  
TGAACATAAATGGTTGGAATTGGACTTTGATTATAATCATATTGTCATTCATAACAGTTTGGCTGATTA  
TCAATTGCTGAGGGTCAGGATTATCCTGCTATTATTCATCTATCTTCTCATCGGAAACCGTGGAAGA  
TTTGGCGGCCCAAAACCTATCGTGAAGTTTGGTGGTACTATCATGGGCTTGAATGGACAGAATTGGGACA  
AAACCATCATTTACATCCATTACAAAGATCTCACATCTATCCAATAAAGGAACCTTTCACTTGTCTAAT  
CTATACTGCCTCAGACCATATTGAACAAATTGAGACATTGGTTCAATCCTTGCCTGATATTCAGTTTAA

Table 1

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GATAGCAGCTAGAGTAATAGTTAGTGATCGATTGGCTCAGATGACAATTTATCCAAACGTGACTATATT  
TAACCGAATTCACATTTTGGTAGATGTCGATAATGAATTGGTAGAAACAGTCAAGTACTTTTAGATAT  
TAATCATGGCGAAAAGACAGAAGAAATTCGATCAATTTGCTAACTTTGGCAAGCCTATCTTATCCTT  
TGAAAATACTAAAACCTATGAAGTAGGTCAGGAGGCATATGCTGTTGACCAAGTTCAGCAATGATTGA  
AAAATTGAGAGAAATAAGCAAA

**SP113 amino acid (SEQ ID NO:200)**

CLDSIIITQYKNIEIVVNDGSTDASGEICKSEMDHRILYIEQENAGLSAARNLTGLNMSGNYVTFV  
DSDDWIEQDYVETLYKKIVEYQADIAVGNYSFNESEGMYFPHILGDSYIEKVYDNVSIFENLYETQEM  
KSFALISAWGKLYKARLFEQLRFDIGKLGEDGYLNQKVYLLSEKVIYLNKSLYAYRIRKGSLSRVWTEK  
WMHALVDAMSERITLLANMGYPLEKHLAVYRQMLEVSLANGQASGLSDTATYKEFEMKQRLNQLSRQE  
ESEKKAIVLAANYGYVDQVLTIIKSICYHNRSIRFYLIHSDFPNEWIKQLNKRLEKFDSEIINCVRVSE  
QISCYKSDISYTVFLRYFIADFVQEDKALYLDCLVVTKNLDDLFATDLQDYPLAAVRDFGGRAYFGQE  
IFNAGVLLVNNAFWKKNMTQKLIIDVTNEWHDKVDQADQSIILNMLFEHKWLELDFDYNHIVHKQFADY  
QLPEGQDYPALIIHLSHRKPKWDLAAQTYREVWYHGLEWTELQGNHHLPLQRSHIYPIKEPFTCLI  
YTASDHIEQIETLVQSLPDIQFKIAARVIVSDRLAQMIIYPNVTIFNGIHYLVVDNELVETSQVLLDI  
NHGEKTEEILDQFANLGKPILSFENTKTYEVGQEAYAVDQVQAMIEKLREISK

**SP114 nucleotide (SEQ ID NO:201)**

CATTCAGAAGCAGACCTATCAAAATCTGGAAATTATCTTGTGATGATGGTGCAACAGATGAAAGTGG  
TCGCTTGTGTGATTCAATCGCTGAACAAGATGACAGGGTGTGAGTGTCTCATAAAGAAACGAAGATT  
GTCGAAGCAGCAAAATGATGGGATGAAGCAGGCTCACGGGGATTATCTGATTTTATTGACTCAGATGA  
TTATATCCATCCAGAAATGATTTCAGAGCTTATATGAGCAATTAGTTCAAGAAGATGCCGATGTTTCGAG  
CTGTGGTGTGATGAATGTCTATGCTAATGATGAAAGCCACAGTCAGCCAATCAGGATGACTATTTTGT  
CTGTGATTCTCAAACATTTCTAAAGGAATACCTCATAGGTGAAAAAATACCTGGGACGATTTGCAATAA  
GCTAATCAAGAGACAGATTGCAACTGCCCTATCCTTTCTAAGGGGTGATTTACGAAGATGCCATTA  
CCATTTTGTATTTAATCAAGTTGGCCAAGAAGTATGTGGTTAATACTAAACCCTATTATTACTATTTCCA  
TAGAGGGGATAGTATTACGACCAAACCCCTATGCAGAGAAGGATTTAGCCTATATTGATATCTACCAAAA  
GTTTTATAATGAAGTTGTGAAAACTATCTGACTTGAAAGAGGTGCGCTTTTTTCAGATTGGCCTATGC  
CCACTTCTTTATCTGGATAAGATGTTGCTAGATGATCAGTATAAACAGTTTGAAGCCTATTCTCAGAT  
TCATCGTTTTTTAAAGGCCATGCCTTTGCTATTTCTAGGAATCCAATTTTCCGTAAGGGGAGAAGAAT  
TAGTGCTTTGGCCCTATTCTATAAATATTTCTTATATCGATTCTTATTACTGAAAAATATTGAAAAATC  
TAAAAAATTACAT

**SP114 amino acid (SEQ ID NO:202)**

IQKQTYQNLZIIIVDDGATDESGRLCDSIAEQDDRVSVLHKKNEGLSQARNDMGMKQARCDYLIFDSDD  
YIHPEMIQSLYEQLVQEDADVSSCGVMNVYANDESQSANQDDYFVCDSTFLKEYLIGEKIPGTICNK  
LIKRIATALSFPKGLIYEDAYYHFDLIKLAKKYVNTKPYYYYFHRGDSITTKPYAEKDLAYIDIYQK  
FYNEVVKNYPLKEVAFFRLAYAHFILDKMLLDDQYKQFEAYSQIHRFLKHGAFISRNPFRKGRRI  
SALALFINISLYRFLLLKNIEKSKKLH

**SP115 nucleotide (SEQ ID NO:203)**

TAAGGCTGATAATCGTGTTCAAATGAGAACGACGATTAATAATGAATCGCCATTGTTGCTTTCTCCGTT  
GTATGGCAATGATAATGGTAACGGATTATGGTGGGGGAACACATTGAAGGGAGCATGGGAAGCTATTCC  
TGAAGATGTAAAGCCATATGCAGCGATTGAACTTCATCCTGCAAAAGTCTGTAAACCAACAAAGTTGTAT  
TCCACGAGATACGAAAGAATTGAGAGAATGGTATGTCAAGATGTTGGAGGAAGCTCAAAGTCTAAACAT  
TCCAGTTTTCTTGGTTATTATGTGCGCTGGAGAGCGTAATACAGTTCCTCCAGAGTGGTTAGATGAACA  
ATTCCAAAAGTATAGTGTGTTAAAAGGTGTTTAAATATTGAGAATTATTGGATTACAAATAACAGTT  
AGCTCCGCATAGTGCTAAATATTTGGAAGTTTGTGCCAAAATATGGAGCGCATTTTATCTGGCATGATCA  
TGAAAAATGGTTCTGGGAACTATTATGAATGATCCGACATTTCTTGAAGCGAGTCAAAAAATATCATAA  
AAATTTGGTGTGGCAACTAAAAATACGCCAATAAGAGATGATGCGGGTACAGATTCTATCGTTAGTGG  
ATTTTGGTTGAGTGGCTTATGTGATAACTGGGGCTCATCAACAGATACATGGAATGGTGGGAAAAACA  
TTATACAAACACATTTGAACTGGAAGAGCTAGGGATATGAGATCCTATGCATCGGAACCAAGATCAAT  
GATTGCTATGGAATGATGAATGTATATACTGGGGAGGCACAGTTTATAATTTGGAATGTGCCCGGTA  
TACATTTATGACAAATGATGTACCAACTCCAGCATTTACTAAAGGTATTATTCTTTCTTTAGACATGC  
TATACAAAAATCCAGCTCCAAGTAAGGAAGAAGTTGTAAATAGAACAAAAGCTGTATTTTGGAAATGGAGA  
AGGTAGGATTAGTTTCAATAACGGATTATTAAGGACTTTATTCGAATGATGAAACAAATGCCTTTATA  
TAATAATGGGAGATATCATATTTCTTCTGTAATACATGAGAAAAATTGATAAGGAAAAGATTTCATCTAT

Table 1

ATTCCCTAATGCAAAAATTTTACTAAAAATAGTGAGGAATTGTCTAGTAAAGTCAACTATTTAAACTC  
GCTTTATCCAAAATTTATGAAGGAGATGGGTATGCTCAGCGTGTAGGTAATTCCTGGTATATTTATAA  
TAGTAATGCTAATATCAATAAAAAATCAGCAAGTAATGTTGCCTATGTATACTAATAATACAAAGTCGTT  
ATCGTTAGATTTGACGCCACATACTTACGCTGTTGTTAAAGAAAATCCAAATAATTTACATATTTTATT  
GAATAATTACAGGACAGATAAGACAGCTATGTGGGCATTATCAGGAAAATTTTGATGCATCAAAAAGTTG  
GAAGAAAGAAGAATTAGAGTTAGCGAACTGGATAAGCAAAAATTTATCCATCAATCCTGTAGATAATGA  
CTTTAGGACAACAACACTTACATTAAGGGGCACTACTGGTCATAAACCTCAGATAAATATAAGTGGCGA  
TAAAAATCATTATACTTATACAGAAAATTTGGGATGAGAATACCCATGTTTATACCATTACGGTTAATCA  
TAATGGAAATGGTAGAGATGTCTATAAATACTAGGGGACAGGTCCAGTCTCTTTCCCAACACCAGATAA  
ATTTAATGATGGTAATTTGAATATAGCATATGCAAAACCAACAACACAAAGTTCGTAGATTACAATGG  
AGACCCTAATAGAGCTGTGGATGGTAACAGAAATGGTAATTTTAACTCTGGTTCGGTAACACACACTAG  
GGCAGATAATCCCTCTTGGTGGGAAGTCGATTGAAAAAAATGGATAAAGTTGGGCTTGTTAAAAATTA  
TAATCGCACAGATGCTGAGACTCAACGTCTATCTAATTTT

**SP115 amino acid (SEQ ID NO:204)**

KADNRVQMRRTINNESPLLLSPLYGNDNGNGLWWGNTLKGAWAIPEDVKPYAAIELHPAKVKCKPTSCI  
PRDTKELREWYVKMLEEAQSLNIPVFLVIMSAGERNTVPPEWLDEQFQKYSVLKGVNLNIENYWIYNNQL  
APHSAKYLEVCAKYGAHFIWHDHEKWFETIMNDPTFEASQKYHKNLVLATKNTPIRDDAGTDSIVSG  
FWLSGLCDNWGSSTDWKKWWEKHYTNTFETGRARDMSYASEPESMIAMEMMNVTGGGTVYNFECAAY  
TFMTNDVPTPAFTKGIIPFFRHAIQNPAPSKEEVVNRKAVFWNGEGRISSLNGFYQGLYNDDETPLY  
NNGRYHILPVIHEKIDKEKISSIFPNAKILTKNSEELSSKVNLYNSLYPKLYEGDGYAQRVGNWSWYIYN  
SNANINKNQVMLPMYTNNTKSLSLDLTPHTYAVVKENPNNLHILLNNYRTDKTAMWALSGNFDASKSW  
KKEELELANWISKNYSINPVDNDFRTTTLTKGHTGHKPKQINISGDKNHYYTENWDENTHYVTITVNH  
NGMVEMSIINTEGTGPVSFPTPKDFNDGNLNIAYAKPTTQSSVDYNGDPNRAVDGNRNGNFNSGSVTHTR  
ADNPSSWEVDLKKMDKVLVKIYNRTDAETQRLSNF

**SP117 nucleotide (SEQ ID NO:205)**

CTGTGGCAATCAGTCAGCTGCTTCCAAACAGTCAGCTTCAGGAACGATTGAGGTGATTTACAGAGAAAA  
TGGCTCTGGGACACGGGGTGCCTTCACAGAAATCACAGGGATTCTCAAAAAGACGGTGATAAAAAAT  
TGACAACACTGCCAAACAGCTGTGATTCAAAATAGTACAGAAGGTGTTCTCTCAGCAGTTCAAGGGAA  
TGCTAATGCTATCGGCTACATCTCCTTGGGATCTTTAACGAAATCTGTCAAGGCTTTAGAGATTGATGG  
TGTCAGAGCTAGTCGAGACACAGTTTTAGATGGTGAATACCCCTCTTCAACGTCCTTCAACATTGTTTG  
GTCTTCTAATCTTTCCAAGCTAGGTCAAGATTTTATCAGCTTTATCCACTCCAAACAAGGTCAACAAGT  
GGTCACAGATAATAAATTTATTGAAGCTAAACCGAAACACCGGAATATACAAGCCAACACTTATCAGG  
CAAGTTGTCTGTTGTAGGTTCCACTTCAGTATCTTCTTAAATGGAAAAATTAGCAGAAGCTTATAAAAA  
AGAAAATCCAGAAGTTACGATTGATATTACCTCTAATGGGTCTTCAGCAGGTATTACCGCTGTTAAGGA  
GAAACCGCTGATATTGGTATGGTTCTTAGGGAATTAACCTCTGAAGAAGGTAAGAGTCTCACCCATGA  
TGCTATTGCTTTAGACGCTATTGCTGTTGTGGTCAATAATGACAATAAGGCAAGCCAAGTCAGTATGGC  
TGAACCTGCAGACGTTTTTAGTGGCAAAATTAACCACTGGGACAAGATTAAA

**SP117 amino acid (SEQ ID NO:206)**

CGNQSAASKQSASGTIEVISRENGSGTRGAFTEITGILKKGDKKIDNTAKTAVIQNSTEGLVSAVQGN  
ANAIGYISLGLTSKSVKALEIDGVKASRDTVLDEYPLQRPFNIVWSSNLSKLGQDFISFIHSKQGQV  
VTDNKFIKAKTETTEYTSQHLGKLSVVGSTSVSSLMEKLAAYKKENPEVTIDITSNGSSAGITAVKE  
KTADIGMVSRELTPPEGKSLTHDAIALDGIADVVMNDNKASQVSMELADVFSGKLTWTDKIK

**SP118 nucleotide (SEQ ID NO:207)**

TTGTCAACAACAACATGCTACTTCTGAGGGGACGAATCAAAGGCAAAGCAGTTCAGCGAAAGTTCCATG  
GAAAGCTTCATACCAACCTAAACAACCAAGGTAAGTACAGAAGAGGTCAAATCTCTCTTATCAGCTCA  
CTTGGATCCAAATAGTGTGATGCATTTTTTAATCTCGTTAATGACTATAATACCATTGTTCGGCTCAAC  
TGGCTTATCAGGAGATTTCACTTCCTTTACTCACACCGAATACGATGTTGAGAAAATCAGTCATCTCTG  
GAATCAAAAAGAAGGGCGATTTTGTGGGACCAACTGCCGTATCAATAGTTATGTCTTTTGAAAAATTC  
AGTCACCATTTCCAAAGCTTGAAAAGAATGACCAAGTGTCTTTTCTAGATAATGATGCGATTGATAAAGG  
AAAGGTCTTTGATTCAAGATAAGGAAGAGTTTGATATTCTATTTTCGAGAGTTCCAACTGAGTCAAC  
TACAGATGTCAAGGTTACGCTGAAAAGATGGAAGCATTCTTCTCACAATTTCAATTCAATGAAAAAGC  
TCGAATGCTGTCTGTAGTCTTGACGACAAATTTGGATGGCGAGTATCTGTTTGTAGGCCACGTTGGGGT  
CTTAGTACCTGCTGATGACGGTTTCTTATTTGTAGAGAAATTGACTTTTGAAGAGCCCTACCAAGCGAT

Table 1

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TAAATTTGCTAGTAAGGAAGATTGCTACAAGTATTTGGGCACCAAGTATGCGGATTATACAGGCGAGGG  
ACTGGCTAAGCCTTTTATCATGGATAATGATAAGTGGGTAAACTT

**SP118 amino acid (SEQ ID NO:208)**

CQQQHATSEGTNQRQSSSAKVPWKASYTNLNNQVSTEEVKSLLSAHLDPNSVDAFFNLVNDYNTIVGST  
GLSGDFTSFTHTEYDVEKISHLWNQKKGDFVGTNCRINSYCLLKNSVTIPKLEKNDQLFLDNDIDAIDKG  
KVFDSQDKEEFDILFSRVPTESSTDVKVHAEKMEAFFSQFQFNEKARMLSVVLHDNLDGEYLFVGHVGV  
LVPADDGFLFVEKLTFEEPYQAIKFASKEDCYKYLGTKYADYTGEGLAKPFI MDNDKWKVVL

**SP119 nucleotide (SEQ ID NO:209)**

TTGTTTCAGGCAAGTCCGTGACTAGTGAACACCAAAGAGATGAAATGAAGACGGAGCAGACAGCTAG  
TAAACAAGCGCAGCTAAAGGGAAAGAGGTGGCTGATTTTGAATTGATGGGAGTAGATGGCAAGACCTA  
CCGTTTATCTGATTACAAGGGCAAGAAAGTCTATCTCAAATCTGGGCTTCTTGGTGTCCATCTGTCT  
GGCTAGTCTTCCAGATACGGATGAGATTGCTAAAGAAGCTGGTGATGACTATGTGGTCTTGACAGTAGT  
GTCACCAGGACATAAGGGAGAGCAATCTGAAGCGGACTTTAAGAATTGGTATAAGGGATTGGATTATAA  
AAATCTCCAGTCCTAGTTGACCCATCAGGCAAACTTTTGAAACTTATGGTGTCCGTCTTACCCAAC  
CCAAGCCTTTATAGACAAAGAAGCAAGCTGGTCAAAACACATCCAGGATTATGAAAAAGATGCAAT  
TTTGCAAACTTTGAAGGAATTAGCC

**SP119 amino acid (SEQ ID NO:210)**

CSGKSVTSEHQTKDEMKTETASKTSAARGKEVADFELMGVDGKTYRLSDYKGGKVYLKFWASWCSICL  
ASLPDTDEIAKEAGDDYVVLTVVSPGHKGEQSEADFKNWKGLDYKNLPVLVDPGKLLLETYGVRSYPT  
QAFIDKEGKLVKTHPGFMEKDAILQTLKELA

**SP120 nucleotide (SEQ ID NO:211)**

CTCGCAAATTGAAAAGCGGCAGTTAGCCAAGGAGGAAAAGCAGTGAAAAAACAGAAATTAGTAAAGA  
CCGAGACTTGCACGAAATTTATCTAGCTGGAGGTTGTTTCTGGGGAGTGAGGAATATTTCTCACGTGT  
TCCCGGGGTGACGGATGCCGTTTTCAGGCTATGCAAAATGGTAGAGGAGAAACAACCAAGTACGAATTGAT  
TAACCAAAACAGGTATGCAGAAACCGTCCATGTCACTATGATGCCAAGCAAATTTCTCTCAAGGAAAT  
CCTGCTTCACTATTTCCGCATTATCAATCCAACCAGCAAAAAATAACAAGGAAATGATGTGGGGACCCA  
GTACCGTACTGGTGTATTATACACAGATGACAAGGATTGGGAAGTGATTAACCAAGTCTTTGATGAGGT  
GGCTAAGAAATACGATCAACCTCTAGCAGTTGAAAAGGAAAACTTGAAGAATTTGTGGTGGCTGAGGA  
TTACCATCAAGACTATCTCAAGAAAAATCCAAATGGCTACTGCCATATCAATGTTAATCAGGCGGCCTA  
TCCTGTCAATTGATGCCAGCAAAATATCCAAAACCAAGTGATGAGGAATTGAAAAAGACCTGTCACTGGA  
GGAGTATGCAGTTACCCAGGAAAAATCAAAACAGAACGAGCTTTCTCAAACCGTTACTGGGATAAATTTGA  
ATCCGGTATCTATGTGGATATAGCAACTGGGGAACCTCTCTTTTCATCAAAAGACAAATTTGAGTCTGG  
TTGTGGCTGGCCTAGTTTACCCAACCCATCAGTCCAGATGTTGTCACCTACAAGGAAGATAAGTCTTA  
CAATATGACGCGTATGGAAGTGCGGAGCCGAGTAGGAGATTCTCACCTTGGGCATGTCTTTACGGATGG  
TCCACAGGACAAGGGCGGCTTACGTTACTGTATCAATAGCCTCTCTATCCGCTTTATCCCAAAGACCA  
AATGAAGAAAAAGGTACGCTTATTTAC

**SP120 amino acid (SEQ ID NO:212)**

SQIEKAAVSQGGKAVKKTEISKDADLHEIYLAGGCFWGVVEYFSRVPGVTDVAVSGYANGRGETTKYELI  
NQTGHAETVHVTYDAKQISLKEILLHYFRIINPTSKNKQGNVGTQYRTGVYTTDDKDLEVINQVFDE  
AKKYDQPLAVEKENLKNFVVAEDYHQDYLLKNPNGYCHINVNQAAYPVIDASKYPKPSDEELKKTLSPE  
EYAVTQENQTERAFSNRYWDFESGIYVDIATGEPLFSSKDKFESGCGWPSFTQPI SPDVVITYKEDKSY  
NMTRMEVRSRVGDSHLGHVFTDGPQDKGLRYCINSLIRFIPKQMEKGTLIY

**SP121 nucleotide (SEQ ID NO:213)**

TTGTCAAGTCAGGTTCTAATGGTTCTCAGTCTGCTGTGGATGCTATCAAACAAAAAGGGAAATTAGTTGT  
GGCAACCAGTCTGACTATGCACCCTTTGAATTTCAATCATTGGTTGATGAAAAGAACAGGTAGTCCG  
TGCAGACATCGACATGGCTCAGGCTATCGCTGATGAACCTGGGGTTAAGTTGGAATCTCAAGCATGAG  
TTTTGACAATGTTTGGACAGTCTTCAAACCTGGTAAGGCTGACCTAGCAGTTGCAGGAATTAGTGCTAC  
TGACGAGAGAAAAAGTCTTTGATTTTCAATCCCATACTATGAAAACAAGATTAGTTTCTTGGTTCCG  
TAAGGCTGATGTGAAAAATAACAAGGATTTAACTAGCCTAGAAAGTGCTAATAATTGCAGCCCCAAAAGG  
GACTGTTCCAGAAATCAATGGTCAAGGAACAATTGCCAAAAGTTCAATTAACCTCCCTAACTAATATGGG  
TGAAGCAGTCAATGAATTGCAGGCTGGAAAAATAGATGCTGTTTATATGGATGAGCCTGTTGCACTTAG

Table 1

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TTATGCTGCTAAAAACGCTGGCTTAGCTGTGCGCAACTGTCAGCTTGAAGATGAAGGACGGCGACGCCAA  
TGCC

**SP121 amino acid (SEQ ID NO:214)**

CQSGSNGSQSAVDAIKQKGLVVATSPDYAPFEFQSLVDGKNQVVGADIDMAQAIADLGVLKLEISSMS  
FDNVLTSLQTKADLAVAGISATDERKEVDFDISIPYYENKISFLVRKADVEKYKDLTSLESANIAAQKG  
TVPESMVKEQLPKVQLTSLTNMGEAVNELQAGKIDAVHMDPEVALSYAAKNAGLAVATVSLKMKDGDAN  
A

**SP122 nucleotide (SEQ ID NO:215)**

GGAACTTCACAGGATTTTAAAGAGAAGAAAACAGCAGTCATTAAGGAAAAAGAAGTTGTTAGTAAAAA  
TCCTGTGATAGACAATAACACTAGCAATGAAGAAGCAAAAATCAAAGAAGAAAATCCAATAAAATCCCA  
AGGAGATTATACGGACTCATTGTGTAATAAAAAACAGAAAATCCCAAAAAGAAGATAAAGTTGTCTA  
TATTGCTGAATTTAAAGATAAAGAATCTGGAGAAAAAGCAATCAAGGAACATCCAGTCTTAAGAATAC  
AAAAGTTTATATACCTTATGATAGAATTTTAAACGGTAGTGCCATAGAAAACAACTCCAGATAACTTGG  
CAAAATTAACAAATAGAAAGGTATTTTCATCGGTTGAAAGGGCACAAAAAGTCCAACCCATGATGAATCA  
TGCCAGAAAGGAAATTTGAGTTGAGGAAGCTATTGATTACCTAAAGTCTATCAATGCTCCGTTTGGGAA  
AAATTTTGATGGTAGAGGTATGGTCATTTCAAATATCGTACTGGAACAGATTATAGACATAAGGCTAT  
GAGAATCGATGATGATGCCAAAGCCTCAATGAGATTTAAAAAGAAGACTTAAAAGGCACTGATAAAAA  
TTATTGGTTGAGTGATAAAATCCCTCATGCGTTCAATTATTATAATGGTGGCAAAATCACTGTAGAAAA  
ATATGATGATGGAAGGGATTATTTTGACCCACATGGGATGCATATTGCAGGGATTCTTGCTGGAAATGA  
TACTGAACAAGACATCAAAAACCTTAAACGGCATAGATGGAATTGCACCTAATGCACAAATTTTCTCTTA  
CAAAATGTATTCTGACGCAGGATCTGGGTTTGGCGGTGATGAAACAATGTTTCATGCTATTGAAGATTC  
TATCAACACAAACGTTGATGTTGTTTTCGGTATCATCTGGTTTACAGGAACAGGTCCTGTAGGTGAGAA  
ATATTGGCAAGCTATTTCGGGCATTAAGAAAAGCAGGCATTCCAATGGTTGTCGCTACGGGTAACATG  
GACTTCTGCTTCAAGTTCTTCATGGGATTTAGTAGCAAATAATCATCTGAAAAATGACCGACACTGGA  
GCTTAACACGAACTGCAGCACATGAAGATGCGATAGCGGTCGCTTCTGCTAAAAATCAAACAGTTGAGTT  
TGATAAAGTTAAACATAGGTGGAGAAAGTTTAAATACAGAAATATAGGGGCCCTTTTCGATAAGAGTAA  
AATCACAACAAATGAAGATGGAACAAAAGCTCCTAGTAAATTAATTTGTATATATAGGCAAGGGGCA  
AGACCAAGATTTGATAGGTTTGGATCTTAGGGGCAAAATTCAGTAATGGATAGAATTTATACAAAGGA  
TTTAAAAAATGCTTTTAAAAAAGCTATGGATAAGGTTGCACGCGCCATTATGGTTGTAAATACGTGAAA  
TTACTACAATAGAGATAATTGGACAGAGCTTCAGCTATGGGATATGAAGCGGATGAAGGTACTAAAAAG  
TCAAGTGTTTTTCAATTTTCAGGAGATGATGGTGTAAGCTATGGAACATGATTAACTCTGATAAAAAAAC  
TGAAGTCAAAAGAAATAATAAAGAAGATTTTAAAGATAAATTTGGAGCAATACTATCCAATTGATATGGA  
AAGTTTAAATTTCAACAAACCGAATGTAGGTGACGAAAAAGAGATTGACTTTAAGTTTGACACCTGACAC  
AGACAAAGAACTCTATAAAGAAGATATCATCGTTCCAGCAGGATCTACATCTTGGGGGCCAAGAATAGA  
TTTACTTTTAAAAACCGATGTTTCAGCACCTGGTAAAAATATTAATCCACGCTTAATGTTATTAATGG  
CAAATCAACTTATGGCTATATGTCAGGAAGTATGTCGAGCTCCAAATCGTGCGAGCTTCTACTGTTTT  
GATTAGACCGAAATTAAGGAAATGCTTGAAGAGCTGTATTGAAAAATCTTAAGGGAGATGACAAAAT  
AGATCTTACAAGTCTTACAAAAATTTGCCCTACAAAATACTGCGCGACCTATGATGGATGCAACTTCTTG  
GAAAGAAAAAAGTCAATACCTTTGCATCACCTAGACAACAGGGAGCAGGCCAATTAATGTGGCCAAATGC  
TTTGAGAAATGAAGTTGTAGCAACTTTCAAAAACACTGATTCTAAAGGTTTGGTAAACTCATATGGTTC  
CATTCTCTTAAAGAAATAAAAGGTGATAAAAAATCTTTACAATCAAGCTTCAATACATCAAAACAG  
ACCTTTTGACTTTTAAAGTTTCAGCATCAGCGATAACTACAGATTCTCTAACTGACAGATTAATACTTGA  
TGAAACATATAAAGATGAAAAATCTCCAGATGGTAAGCAAATTTGTTCCAGAAATTCACCCAGAAAAAGT  
CAAAGGAGCAAATATCACATTTGAGCATGATACTTTCACTATAGGCGCAAATTCAGCTTTGATTGAA  
TGCGGTTATAAATGTTGGAGAGGCCAAAAACAAAAATAAATTTGTAGAATCATTTATTCATTTTGTGATC  
AGTGGAAGCGATGGAAGCTCTAACTCCAGCGGAAGAAAAATAAATTTCCAACCTTCTTTGTGCGATGCC  
TCTAATGGGATTTGCTGGGAATTTGAACACCAACCAATCCTTGATAAATGGGCTTGGGAAGAAGGGTC  
AAGATCAAAAACACTGGGAGGTTATGATGATGATGGTAAACCGAAAAATTCAGGAACCTTAAATAAGGG  
AATTGGTGGAGAAACATGGTATAGATAAATTTAATCCAGCAGGAGTTATACAAAAAGAAAAGATAAAAA  
TACAACATCCCTGGATCAAAATCCAGAATTTATTTGCTTTCAATAACGAAGGGATCAACGCTCCATCATC  
AAGTGGTTCTAAGATTGCTAACATTTATCCTTTAGATTCAAAATGGAAATCCTCAAGATGCTCAACTTGA  
AAGAGGATTAACACCTTCTCCACTTGTATTAAGAAGTGCAGAAGAAGGATTGATT

**SP122 amino acid (SEQ ID NO:216)**

ETSQDFKEKKTAVIKEKEVSKNPVIDNNTSNEEAKIKEENSNSQGDYTDTSFVNKNTENPKKEDKVYV  
IAEFKDKESGEKAIKELSSLKNTKVLYTYDRIFNGSAIETTPDNLDKIKQIEGISSVERAQKVQPMNH

Tabl 1

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ARKEIGVEEAIDYLK SINAPFGKNFDGRGMVISNIDTGT DYRHKAMRIDDDAKASMRFKKEDLKGT DKN  
YWLSDKI PHAFNYNNGGKITVEKYDDGRDYFDPHGMHIAIGILAGNDTEQDIKNFNGIDGIAPNAQIFSY  
KMYSDAGSGFAGDETMFHAIEDSIKHNVVVSVSSGFTGTGLVGEKYWQAIRALRKAGIPMVVATGNYA  
TSASSSSWDLVANNHLKMTDTGNVTRTAHEDAI AVASAKNOTVEFDKVNIGGESFKYRNIGAFFDKSK  
ITTNEDGT KAPSKLFVYIGKQDQDLIGLDLRGKIAVMDRIYTKDLKNAFKKAMDKGARAIMVVNTVN  
YYNRDNWTEL PAMGYEADGKTSQVFSISGDDGVKLWNMINPDKKTEVKRNNKEDFKDKLEQYYPIDME  
SFNSNKP NVGDEKEIDFKFAPD TDKELYKEDIIVPAGSTSWGPRIDLLLPDVSAPGKNIKSTLN VING  
KSTYGYMSGTSMATPIVAASTVLIRPKLKEMLERPVLKNLKGDDKIDLTSLTKIALQNTARPMMDATSW  
KEKSQYFASPRQQAGLINVANALRNEVATFFKNTDSKGLVNSYGSISLKEIKGDKKYFTIKLHNTSNR  
PLTFKVSASAITTDSLTDRLKLDETYKDEKSPDGKQIVPEIHPEKVKGANITFEHDTFTIGANSSFDLN  
AVINVGEAKNKNKFVESFIHFESVEAMEALNSSGKKINFQPSLSMPLMGFAGNWNHEPILDKWAWEEGS  
RSKTLGGYDDDGKPKIPGTLNKGIGGEHGIDKFNPAGVIQNRKDKNTTSLDQNP ELF AFNNEG INAPSS  
SGSKIANIYPLDSNGNPQDAQLERGLTPSPLVLRSAEEGLI

**SP123 nucleotide (SEQ ID NO:217)**

TGTGGTCGAAGTTGAGACTCCTCAATCAATAACAAATCAGGAGCAAGCTAGGACAGAAAACCAAGTAGT  
AGAGACAGAGGAAGCTCCAAAAGAAGAAGCACCTAAAACAGAAGAAAGTCCAAAGGAAGAACCAAAATC  
GGAGGTAAACCTACTGACGACACCCCTTCCTAAAGTAGAAGAGGGGAAAGAAGATTACGACAGAACCAAGC  
TCCAGTTGAAGAAGTAGGTGGAGAAGTTGAGTCAAAACAGAGGAAAAAGTAGCAGTTAAGCCAGAAAAG  
TCAACCATCAGACAAACAGCTGAGGAATCAAAAGTTGAACAAGCAGGTGAACCAAGTCCGCGCCAAAGAGA  
AGACGAAAAGGCCACAGTCGAGCCAGAAAAGCAACCAAGAGCTCCTGAAGAAGAGAAGGCTGTAGAGGA  
AACACCGAAACAAGAAGAGTCAACTCCAGATACCAAGGCTGAAGAAACTGTAGAACCAAAAGAGGAGAC  
TGTTAATCAATCTATTGAACAACCAAAAGTTGAACGCCTGCTGTAGAAAAACAAACAGAACCAACAGAGA  
GGAACCAAAAGTTGAACAAGCAGGTGAACCAAGTCCGCGCCAAAGAGAAGACGAACAGGCACCAACCGCACC  
AGTTGAGCCAGAAAAGCAACCAAGTTCCTGAAGAAGAGAAGGCTGTAGAGGAAACACCGAAACCAAGAGA  
AGATAAAATAAAGGTTATGCTACTAAAGAACCAGTTGATAAAAGTGAGTTAAATAATCAAAATTGATAA  
AGCTAGTTCAAGTTCTCCTACTGATTATTCTACAGCAAGTTACAATGCTCTTGACCTGTTTTAGAAAC  
TGCAAAAGGTGCTATGCTTCAGAGCCTGTAAAACAGCCTGAGGTAAATAGCGAGACAAATAAACTTAA  
AACGGCTATTGACGCTCTAAACGTTGATAAACTGAATTAACAATACGATTGCGAGATGCAAAAACAAA  
GGTAAAAGAACATTACAGTGATAGAAAGTTGGCAAAACCTCCAACTGAAGTTACAAGGCTGAAAAAGT  
TGCAGCTAATACAGATGCTAAACAAGTGAAGTTAACGAAGCTGTTGAAAAATTAACTGCAACTATGTA  
AAAATTGGTTGAATTATCTGAAAAGCCAATATTAACATTGACTAGTACCGATAAGAAAATATTTGGAACG  
TGAAAGCTGTTGCTAAGTATACTCTAGAAAATCAAAACAAAACAAAATCAAATCAATCACAGCTGAATT  
GAAAAAAGGAGAAGAAGTTATTAATACTGTAGTCCTTACAGATGACAAGGTAACAACAGAACTATAAG  
CGCTGCATTTAAGAACCTAGAGTACTACAAAGAATACACCCTATCTACAACTATGATTTACGACAGAGG  
TAACGGTGAAGAACTGAAACTCTAGAAAATCAAAATATTCAATTAGATCTTAAAAAAGTTGAGCTTAA  
AAATATTAAACGTACAGATTTAATCAAAATACGAAAATGGAAAAGAACTAATGAATCACTGATAACAAC  
TATTCCTGATGATAAGAGCAATTATTATTTAAAAATAACTTCAAATAATCAGAAAACCTACATTACTAGC  
TGTTAAAAATATAGAAGAACTACGGTTAACGGAACACCTGTATATAAAGTTACAGCAATCGCAGACAA  
TTTAGTCTCTAGAACTGCTGATAATAAATTTGAAGAAGAA

**SP123 amino acid (SEQ ID NO:218)**

VVEVETPQSITNQEQARTENQVVETEEAPKEEAPKTEESPKEPKSEVKPTDDTLPKVEEGKEDSAEPA  
PVEEVGGEVESKPEEKVAVKPESQPSDKPAEESKVEQAGEPVAPREDEKAPVEPEKQPEAPEEEKAVEE  
TPKQEESTPDTKAETVEPKETVNSIEQPKVETPAVEKQTEPTEEPKVEQAGEPVAPREDEQAPTAP  
VEPEKQPEVPEEEKAVEETPKPEDKIKIGIGTKEPVDKSELNNQIDKASSVSPTDYSTASYNALGPVLET  
AKGVYASEPVKQPEVNSETNKLKTAIDALNVDKTELNNNTIADAKTKVKEHYSRDSWQNLQTEVTKAEKV  
AANTDAKQSEVNEAVEKLTATIEKLVELSEKPIILTLTSTDKKILEREAVAKYTLENQNKTKIKSITAE  
KKGEEVINTVVLTDKVTETISAAFKNLEYKEYTLSTMIYDRNGEETETLENQNIQLDLKKVELK  
NIKRTDLIKYENGKETNESLITIPDDKSNNYLLKITSNNQKTTLLAVKNIEETTNGTPVYKVTAIADN  
LVSRTADNKFEE

**SP124 amino acid (SEQ ID NO:219)**

AACACCTGTATATAAAGTTACAGCAATCGCAGACAATTTAGTCTCTAGAACTGCTGATAATAAATTTGA  
AGAAGAATACGTTCACTATATTGAAAAACCTAAAGTCCACGAAGATAATGTATATTATTAATTTCAAAGA  
ATTAGTGGAAGCTATTCAAACGATCCTTCAAAGAATATCGTCTGGGACATCAATGAGCGCTAGAAA  
TGTTGTTCCCTAATGGAAAATCATATATCACTAAAGAATTCACAGGAAAACCTTTAAGTCTGAAGGAAA  
ACAATTTGCTATTACTGAATTGGAACATCCATTATTTAATGTGATAACAAACGCAACGATAAATAATGT

Table 1

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GAATTTTAAAAATGTAGAGATAGAACGTTCTGGTCAAGATAATATTGCATCATTAGCCAATACTATGAA  
AGGTTCTTCAGTTATTACAAATGTCAAAATTACAGGCACACTTTCAGGTCGTAATAATGTTGCGATT  
TGTAATAATATGAATGATGGAACCTCGTATTGAAAATGTTGCTTTCTTTGGCAAACTACACTCTACAAG  
TGGAAATGGCTCTCATACAGGGGGAATTGCAGGTACAACTATAGAGGAATTGTTAGAAAAGCATATGT  
TGATGCTACTATTACAGGAAACAAAACACGCCAGCTTGTAGTTCCTAAAGTAGATTATGGATTAAC  
TCTAGACCATCTTATTGGTACAAAAGCTCTCCTAACTGAGTCGGTTGTAAAAGGTAAAATAGATGTTTC  
AAATCCAGTAGAAGTTGGAGCAATAGCAAGTAAGACTTGGCCTGTAGGTACGGTAAGTAATTCGTGTCAG  
CTATGCTAAGATTATCCGTGGAGAGGAGTTATTCGGCTCTAACGACGTTGATGATTCTGATTATGCTAG  
TGCTCATATAAAAGATTATATGCGGTAGAGGGATATTTCGTCAAGTAATAGATCATTTAGGAAATCTAA  
AACATTTACTAAATTAACATAAGAACAGCTGATGCTAAAAGTTACTACTTTCAATATTACTGCTGATAA  
ATTAGAAAGTGATCTATCTCTCTTGCAAACTTAATGAAGAAAAAGCCTATTCTAGTATTCAAGATTA  
TAACGCTGAATATAACCAAGCCTATAAAATCTTGAAAAATTAATACCATTCTACAATAAAGATTATAT  
TGTATATCAAGGTAATAAATTAAATAAAGAACACCATCTAAATACTAAAGAAGTTCTTTCTGTTACCGC  
GATGAACAACATGAGTTTATCACAACCTAGATGAAGCTAATAAAATTATTGTTCACTATGCGGACGG  
TACAAAAGATTACTTTAACTTGCTTCTAGCAGTGAAGGTTAAGTAATGTAAAAGAAATATACTATAAC  
TGACTTAGGAAATTAATAATACACCTAATATCGTTTCAAAAAGATAACACTACTCTGTTAATGATATAAA  
ATCTATTTTAGAATCAGTAGAGCTTCAGTCTCAAACGATGTATCAGCATCTAAATCGATTAGGTGACTA  
TAGAGTTAATGCAATCAAAGATTTATATTAGAAGAAAGCTTCACAGATGTTAAAGAAAACTTAACAAA  
CCTAATCACAAAATTAGTTCAAAACGAAGAACATCAACTAAATGATTCTCCAGCTGCTCGTCAAAATGAT  
TCGTGATAAAGTCGAGAAAAACAAAGCAGCTTTATTACTAGGTTTAACTTACCTAAATCGTTACTATGG  
AGTTAAATTTGGTGATGTTAATATTAAAGAATTAAATGCTATTCAAACCCAGATTCTATGGTGAAAAAGT  
TAGCGTATTAGACAGATTAATTGAAATCGGTTCTAAAGAGAACAACATTAAAGGTTACCGTACATTCTGA  
CGCATTCGGTCAAGTA

**SP124 amino acid (SEQ ID NO:220)**

TPVYKVTAIADNLVSRTADNKFEEYVHYIEKPKVHEDNVYVNFKELVEAIQNDPSKEYRLGQSMARN  
VVPNGKSYITKEFTGKLLSSEKQFAITELEHPLFNVITNATINNUNFENVEIERSGQDNIAASLANTMK  
GSSVITNVKITGTLSGRNNVAGFVNMNDGTRIENVAFFGKLHSTSGNGSHTGGIAGTNYRGIVRKAYV  
DATITGNKTRASLLVPKVDYGLTLDHLIGTKALLTESVVKGIDVSNPVEVGAISKTPVPGTVSNSVS  
YAKIIRGEELFGSNDVDDSDYASAHIKDLYAVEGYSSGNRSFRKSKTFKLTKEQADAKVTFNITADK  
LESLSPLAKLNEEKAYSSIQDYNAEYNQAYKNLEKLIPFYNKDYIVYQGNKLNKEHHLNLTKEVLSVTA  
MNNNEFITNLDEANKIIVHYADGTDYFNLSSESSEGLSNVKEYTITDLGIKYTPNIVQKNDNTLVNDIK  
SILESVELQSQTMVQHLNRLGDYRVNAIKDLYLEESFTDVKENLNLITKLVQNEEHQLNDSPPAARQMI  
RDKVEKNKAALLGLTYLNRYYGKFGDVNIKELMLFKPDFYGEKVSVDRLIEIGSKENNIKGSRTFD  
AFGQV

**SP125 nucleotide (SEQ ID NO:221)**

ATTAGACAGATTAAATTGAAATCGGTTCTAAAGAGAACAACATTAAAGGTTACAGTACATTTCGACGCATT  
CGGTCAAGTATTGGCTAAATATACTAAATCAGGTAATTTAGATGCATTTTAAATTATAATAGACAATT  
GTTACAAAATATAGACAATATGAACGATTGGTTTATTGATGCTACAGAAGACCATGTCTACATCGCAGA  
ACGCGCTTCTGAGGTCGAAGAAATTAATAATCTAAACATCGTGCATTTCGATAATTTAAACGAAGTCA  
CCTTAGAAATACTATACTCCCACTACTGAATATTGATAAAGCACATCTTTATTTAATTTCAAATTATAA  
TGCAATTGCCTTTGGTAGTGCAGAGCGATTAGGTAAAAAATCATTAGAAGATATTAAAGATATCGTTAA  
CAAAGCTGCAGATGGTTATAGAACTATTATGATTTCTGGTATCGTCTAGCGTCTGATAACGTTAAACA  
ACGACTACTAAGAGATGCTGTTATTCTATTGGGAAGGTTATAACGCTCCTGGTGGATGGGTTGAAAA  
ATATGGCCGCTATAATACCGACAAAGTATATACTCCTCTTAGAGAATTCTTTGGTCTATGGATAAGTA  
TTATAATTATAATGGAACAGGAGCTTATGCTGCTATATATCCTAACTCTGATGATATTAGAACTGATGT  
AAAATATGTTTCAATTAGAAATGGTTGGTGAATACGGTATTTCAAGTTTACACACATGAAACAACACACGT  
CAACGACCGTGGGATTTACTTAGGTGGCTTTGGACACCGTGAAGGTACTGATGCTGAAGCATATGCTCA  
GGGTATGCTACAACTCCTGTTACTGGTAGTGGATTGATGAGTTTGGTCTTTAGGTATTAAATATGGT  
ATTTAAACGCAAAAAATGATGGGAATCAGTGGTATATTACAGATCCAAAAACTCTAAAAACACGAGAAGA  
TATTAATAGATATATGAAGGGTTATAATGACACTTTAACTCTCTTGATGAAATTGAGGCTGAATCTGT  
GATTTCTCAACAAAAATAAGATTTAAATAGTGCATGGTTCAAAAAAATAGATAGAGAATACCGTGATAA  
CAATAAATTAATCAATGGGATAAAATTCGAAATCTAAGTCAAGAAGAGAAAAATGAATTAATATTCA  
ATCTGTTAATGATTAGTTGATCAACAATTAATGACTAATCGCAATCCAGGTAATGGTATCTATAAACC  
CGAAGCAATTAGCTATAACGATCAATCACTTATGTAGGTGTTAGAATGATGACCGGTATCTACGGAGG  
TAATACTAGTAAAGGTGCTCCTGGAGCTGTTTCAATCAACATAATGCTTTTAGATTATGGGTTACTA  
CGGATACGAAAAATGGGTTCTTAGGTTATGCTTCAATAAATATAAACAACAATCTAAACAGATGGTGA



Table 1

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GTCTGTTCTAAGTGATGAATATATTATCAAGAAAATATCTAACAATACATTTAATACTATTGAAGAATT  
TAAAAAAGCTTACTTCAAAGAAGTTAAAGATAAAGCAACGAAAGGATTAACAACATTCGAAGTAAATGG  
TTCTTCCGTTTCATCATACGATGATTTACTGACATTGTTTAAAGAAGCTGTTAAAAAAGATGCCGAAAC  
TCTTAAACAAGAAGCAAACGGTAATAAAACAGTATCTATGAATAATACAGTTAAATTTAAAGAAGCTGT  
TTATAAGAACTTCTTCAACAAACAAATAGCTTTAAACTTCAATCTTTAA

**SP125 amino acid (SEQ ID NO:222)**

LDRLIEIGSKENNIKGSRTFDFGQVLAKYTKSGNLDAFLNYNRQLFTNIDNMNDWFIDATEDHVYIAE  
RASEVEEIKNSKRAFNDLKRSHLRNTILPLLNDIDKAHLYLISYNAIAFGSAERLGKKSLEDIKDIVN  
KAADGYRNYDFWYRLASDNVQRLRLDAVPIWEGYNAPGGWVEKYGRYNTDKVYTPLRFFGPMCKY  
YNYNGTGAYAAIYPNSDDIRTDVKYVHLEMGVEYGISVYTHETHVNDRAIYLGFGHREGTDAEAYAQ  
GMLQTPVTGSGFDEFGLGINMVFKRKNDGNQWYITDPKTLKTREDINRYMKGYNDTLTLLEIEAESV  
ISQQNKDLNSAWFKKIDREYRDNNKLNQWDKIRNLSQEEKNELNIQSVNDLVDQQLMTRNPNPGNGIYKP  
EASINDQSPYVGVMMTGIYGGNTSKGAPGAVSFKHNAFRLWGYGYENGFLGYASNKYKQSKTDGE  
SVLSDEYIIKKISNMTFNTIEEFKAYFKEVKDKATKGLTTFEVNGSSVSSYDDLLTLFKEAVKKDAET  
LKQEAENGKTVSMNNTVKLEAVYKLLQQTNSFKTSIFK

**SP126 nucleotide (SEQ ID NO:223)**

TAAGACAGATGAACGGAGCAAGGTGTTGACTTTTCCATTCCCTACTATACTGCAAAAAATAAACTCAT  
TGCTCAAAAAATCTGACTTGACTACTTATCAGTCTGTAAACGACTTGGCGCAGAAAAAGGTTGGAGCGCA  
GAAAGGTTTCGATTCAAGAGACGATGGCGAAAGATTTGCTACAAAAATCTTCCCTCGTATCTCTGCCTAA  
AAATGGGAATTTAATCACAGATTTAAATCAGGACAAGTGGATGCCGTTATCTTTGAAGAACCTGTTTC  
CAAGGGATTTGTGAAAATAATCCTGATTTAGCAATCGCAGACCTCAATTTTGAAGAAGCAAGATGA  
TTCTTACGCGGTAGCCATGAAAAAGATAGCAAGAAATTGAAGAGGCAGTTCGATAAAACCATTCAAAA  
GTTGAAGGAGTCTGGGGAATTAGACAAACTCATTGAGGAAGCCTTA

**SP126 amino acid (SEQ ID NO:224)**

KTDERSKVDFDSIPYYTAKNKLIVKSDLTTYQSVNDLAQKKVGAQKGSIQETMAKDLLQNSSLVSLPK  
NGNLITDLKSGQVDAVIFEEPVSCKGFVENNPDLAIADLNFEKEQDDSYAVAMKKDSKKLKRQFDKTIQK  
LKESGELDKLIEEAL

**SP127 nucleotide (SEQ ID NO:225)**

CTGTGAGAATCAAGCTACACCCAAAGAGACTAGCGCTCAAAAGACAATCGTCCTTGCTACAGCTGGCGA  
CGTGCCACCATTGACTACGAAGACAAGGGCAATCTGACAGGCTTTGATATCGAAGTTTAAAGGCAGT  
AGATGAAAAACTCAGCGACTACGAGATTCAATTCCAAAGAACCGCTGGGAGAGCATCTTCCCAGGACT  
TGATTCTGGTCACTATCAGGCTGCGGCCAATAACTTGAGTTACACAAAAGAGCGTGCTGAAAAATACCT  
TTACTCGCTTCCAATTTCCAACAATCCCCCTCGTCCTTGTCAGCAACAAGAAAAATCCTTGACTTCTCT  
TGACCAGATCGCTGGTAAACAACACAAGAGGATACCGGAACCTTCAACGCTCAATTCATCAATAACTG  
GAATCAGAAAACACACTGATAATCCCGCTACAATTAATTTTCTGGTGAGGATATTGGTAAACGAATCCT  
AGACCTTGCTAACGGAGAGTTTGATTTCTTAGTTTTTGACAAGGTATCCGTTCAAAGATTATCAAGGA  
CCGTGGTTTAGACCTCTCAGTCGTTGATTTACCTTCTGCAGATAGCCCCAGCAATTATATCATTCTCTC  
AAGCGACCAAAAAGAGTTTAAAGAGCAATTTGATAAAGCGCTCAAAGAACTCTATCAAGACGGAACCTT  
TGAAAACTCAGCAATACCTATCTAGGTGGTTCTTACCTCCCAGATCAATCTCAGTTACAA

**SP127 amino acid (SEQ ID NO:226)**

CENQATPKETSAQKTIVLATAGDVPPFDYEDKGNLTGFDIEVLKAVDEKLSDEYIQFORTAWESIFPGL  
DSGHYQAAANNLSYTKERAKEYLYSLPISNNPLVLVSNKKNPLTSLDQIAGKTTQEDTGTSTNAQFINNW  
NQKHTDNPATINFSGEDIGKRILDLANGEFDLFLVFDKVSQKIIKDRGLDLSVVDLPSADSPSNYIIFS  
SDQKEFKEQFDKALKELYQDGTLEKLSNTYLGGSYLPDQSQLO

Tablo 2  
*S. pneumoniae* Antigenic Epitopes

**SP001**

Lys-1 to Ile-10; Leu-13 to Lys-32; Arg-41 to Ile-51; Ser-85 to Glu-97; Ala-159 to His-168; Val-309 to Thr-318; Val-341 to Asn-352; Asn-415 to Met-430; Phe-454 to Asn-464; Ser-573 to Gly-591; Asn-597 to Thr-641; and Asn-644 to Ala-664.

**SP004**

Thr-9 to Thr-24; Ile-29 to Ala-48; Thr-49 to Val-56; Val-286 to Val-312; Pro-316 to Glu-344; Val-345 to Ile-367; Gln-368 to Val-399; Ser-400 to Glu-431; Asn-436 to Ala-457; Ile-467 to Ala-498; and Thr-499 to Glu-540.

**SP006**

Glu-1 to Lys-13; Pro-24 to Gly-36; Val-104 to Thr-112; Ala-118 to Asn-130; Trp-137 to Ala-146; Ser-151 to Ile-159; Ile-181 to Leu-188; and Pro-194 to Tyr-202.

**SP007**

Gly-1 to Asn-7; Tyr-24 to Gln-34; His-47 to Phe-55; Ser-60 to Ala-67; Ala-122 to Leu-129; Leu-221 to Lys-230; Val-236 to Phe-256; and Asp-271 to Gly-283; and Leu-291 to Asp-297.

**SP008**

Leu-4 to Lys-17; Gln-24 to Leu-32; Asp-60 to Ser-66; Ser-70 to Asp-76; Ala-276 to Lys-283; Asn-304 to Lys-311; and Thr-429 to Pro-437.

**SP009**

Thr-4 to Glu-11; Leu-50 to Asp-60; Ile-102 to Trp-123; and Ser-138 to Ile-157.

**SP010**

Phe-34 to Gly-41; Asp-44 to Lys-50; Leu-172 to Val-186; Leu-191 to Val-198; Ser-202 to Ile-209; and Val-213 to Leu-221.

**SP011**

Asn-2 to Thr-10; Asp-87 to Ala-102; Tyr-125 to Glu-132; Thr-181 to Tyr-189; Arg-217 to Thr-232; Asn-257 to Lys-264; Pro-271 to Ser-278; Tyr-317 to Ala-325; Glu-327 to Pro-337; and Thr-374 to Val-381.

**SP012**

Gly-1 to Lys-19; Phe-34 to Tyr-41; Leu-109 to Lys-126; and Leu-231 to Glu-247.

**SP013**

Ala-1 to Lys-12; Ile-42 to Pro-53; Leu-138 to Lys-146; Ile-205 to Lys-217; Ser-235 to Ile-251; and Ser-261 to Tyr-272.

**SP014**

Gly-1 to Val-16; Leu-35 to Leu-44; Asp-73 to Asp-81; Ile-83 to Asp-92; Glu-145 to Ile-153; Phe-188 to Asn-196; Ser-208 to Phe-215; Ile-224 to Leu-231; and Asn-235 to Ala-243.

**SP015**

Ser-1 to Pro-16; Asn-78 to Glu-88; Ala-100 to Val-108; Ala-122 to Thr-129; Thr-131 to Ser-137; Leu-201 to Ser-220; and Gly-242 to Val-251.

Table 2  
*S. pneumoniae* Antigenic Epitopes

**SP016**

Gly-1 to Glu-20; Thr-30 to Val-38; Gln-94 to Asn-105; Lys-173 to Pro-182; Gly-189 to Arg-197; Ser-207 to Val-224; Pro-288 to Leu-298; Ala-327 to Ala-342; and Ser-391 to Ala-402.

**SP017**

Ser-1 to Thr-12; Ala-36 to Tyr-45; Gln-48 to Ile-54; Lys-59 to Lys-76; Tyr-113 to Leu-138; and Phe-212 to Asp-219.

**SP019**

Val-97 to Glu-117; Asp-163 to Leu-169; Thr-182 to Thr-191; and Lys-241 to Ser-250.

**SP020**

Asn-18 to Lys-25; Thr-47 to Glu-60; Trp-75 to Val-84; Gly-102 to Val-110; Pro-122 to Ala-131; and Glu-250 to Pro-258.

**SP021**

Ser-1 to Asp-8; Val-44 to Asp-54; Ala-117 to Val-125; Thr-165 to Thr-173; and Glu-180 to Pro-189.

**SP022**

Phe-5 to Lys-13; Thr-20 to Ser-36; Glu-59 to Lys-81; Tyr-85 to Gly-93; Trp-94 to Trp-101; and Thr-195 to Trp-208.

**SP023**

Gln-45 to Glu-59; Asp-69 to Pro-85; Lys-111 to Asn-121; Pro-218 to Ala-228; and Glu-250 to Asn-281.

**SP025**

Gln-14 to Thr-20; Gly-27 to Phe-33; Gly-63 to Glu-71; and Ile-93 to Phe-102.

**SP028**

Asp-171 to Pro-179; Tyr-340 to Glu-350; Pro-455 to Tyr-463; and Asp-474 to Pro-480.

**SP030**

Leu-22 to Leu-37; Trp-81 to Ala-90; Phe-101 to Ala-106; Thr-124 to Tyr-130; and Asn-138 to Glu-144.

**SP031**

Asp-8 to Val-16; Gly-27 to Thr-35; Gly-178 to Asp-195; Thr-200 to Asp-209; Trp-218 to Leu-224; and Lys-226 to Asp-241.

**SP032**

Ser-9 to Asp-28; Phe-31 to Val-40; Gly-42 to Arg-50; Ile-52 to Leu-60; Asp-174 to Phe-186; Leu-324 to Met-333; and Thr-340 to Asn-347.

**SP033**

Gln-2 to Ile-13; Phe-46 to Ile-53; and Asp-104 to Thr-121.

**SP034**

Glu-36 to Gly-43; Ala-188 to Asp-196; Trp-313 to Gly-320; and Leu-323 to Leu-329.

Table 2  
*S. pneumoniae* Antigenic Epitopes

**SP035**

Arg-19 to Asp-36; Asp-47 to Val-57; Asn-134 to Thr-143; Asp-187 to Arg-196; and Glu-222 to Ser-230.

**SP036**

Arg-10 to Arg-17; Lys-29 to Ser-39; Ser-140 to Ala-153; Arg-158 to Tyr-169; Asp-175 to Ala-183; Gly-216 to Asn-236; Ala-261 to Leu-270; Arg-282 to Phe-291; and Thr-297 to Ala-305; Pro-342 to Gln-362; Phe-455 to Asp-463; His-497 to Thr-511; Ala-521 to Gly-529; Ile-537 to Val-546; Ile-556 to Ala-568; Pro-581 to Ser-595; Glu-670 to Ala-685; Ser-696 to Ala-705 and Leu-782 to Ser-791.

**SP038**

Glu-61 to Pro-69; Phe-107 to Ala-115; Leu-130 to Tyr-141; Ala-229 to Glu-237; Ser-282 to Asn-287; Ala-330 to Glu-338; and Tyr-387 to Glu-393.

**SP039**

Ser-28 to Asp-35; Pro-88 to Pro-96; Leu-125 to Arg-135; Phe-149 to Leu-157; Gln-246 to Val-254; Ala-357 to Thr-362; Gly-402 to Lys-411; and Leu-440 to Pro-448.

**SP040**

Thr-21 to Ile-30; His-54 to Gln-68; Arg-103 to Leu-117; and Thr-127 to Leu-136.

**SP041**

Gly-36 to Asp-49; Leu-121 to Val-128; and Ala-186 to Ile-196.

**SP042**

Gly-11 to Arg-19; Ile-23 to Lys-31; His-145 to Asn-151; Gln-159 to Asp-166; Ile-175 to Asp-181; Gly-213 to Tyr-225; Ile-283 to Val-291; Pro-329 to Glu-364; Arg-372 to Ser-386; Thr-421 to Phe-430; Leu-445 to Val-453; Ile-486 to Ala-497; Asp-524 to Ala-535; His-662 to Gly-674; and His-679 to Gln-702.

**SP043**

Lys-2 to Asp-12; Val-58 to Asn-68; Ser-87 to Asp-95; and Asp-102 to Lys-117.

**SP044**

Gln-3 to Lys-11; Asp-37 to Tyr-52; Glu-171 to Leu-191; His-234 to Asn-247; and Asn-283 to Ala-291.

**SP045**

Tyr-52 to Ile-63; Asp-212 to Gln-227; Ser-315 to Thr-332; Leu-345 to Phe-354; Asp-362 to Val-370; Thr-518 to Asn-539; Ala-545 to Lys-559; and Val-601 to Pro-610.

**SP046**

Gln-9 to Ala-18; Glu-179 to Lys-186; Lys-264 to Glu-271; Gly-304 to Glu-17; Ser-503 to Asn-511; Asn-546 to Thr-553; and Asn-584 to Asp-591.

**SP048**

Table 2

*S. pneumoniae* Antigenic Epitopes

Tyr-4 to Asp-25; Lys-33 to Val-70; Asp-151 to Thr-170; Asp-222 to Val-257; Thr-290 to Phe-301; and Gly-357 to Val-367.

**SP049**

Ala-23 to Arg-37; Tyr-85 to Gln-95; Glu-106 to Ile-118; Arg-131 to Ile-144; Gly-150 to Ser-162; and Ala-209 to Asp-218.

**SP050**

Asp-95 to Glu-113; Gly-220 to Gly-228; Asn-284 to Glu-295; Thr-298 to Val-315.

**SP051**

Lys-16 to Glu-50; Lys-57 to Asn-104; Ser-158 to Trp-173; Asp-265 to Pro-279; Val-368 to Tyr-386; Glu-420 to Ile-454; Pro-476 to Ile-516; Phe-561 to Gly-581; Thr-606 to Gly-664; and Glu-676 to Val-696.

**SP052**

Asn-41 to Tyr-60; Phe-80 to Glu-103; Ala-117 to Val-139; Ile-142 to Leu-155; Val-190 to Lys-212; Glu-276 to Phe-283; Arg-290 to Ser-299; Leu-328 to Val-351; Gly-358 to Thr-388; Glu-472 to Ala-483; Val-533 to Asn-561; Asp-595 to Val-606; Glu-609 to Val-620; Glu-672 to Ser-691.

**SP053**

Ala-62 to Val-101; Thr-147 to Leu-174; Lys-204 to Val-216; Gln-228 to Val-262; Ser-277 to Gly-297; Thr-341 to Gly-368; Thr-385 to Ala-409; Thr-414 to Ser-453; Asn-461 to Leu-490; Glu-576 to Thr-625; Gly-630 to Arg-639; and Asp-720 to Leu-740.

**SP054**

Glu-7 to Val-28; and Tyr-33 to Glu-44.

**SP055**

Pro-3 to Val-18; Thr-21 to Lys-53; Val-84 to Lys-99; Ile-162 to Val-172; and Val-204 to Ser-241.

**SP056**

Val-34 to Tyr-41; Leu-47 to Glu-55; and Pro-57 to Gln-66.

**SP057**

Asp-1 to Val-25; Pro-29 to Ile-80; Asn-96 to Val-145; and Pro-150 to Glu-172.

**SP058**

Ala-64 to Thr-70; Leu-82 to His-138; and Val-228 to Asn-236.

**SP059**

Val-10 to Thr-24; Ser-76 to Pro-102; Ser-109 to Ile-119; Ser-124 to Val-130; Thr-186 to Ile-194; and Asn-234 to Ser-243.

**SP060**

Leu-70 to Arg-76; and Val-79 to Ile-88.

**SP062**

Glu-14 to Lys-28; Ser-32 to Lys-46; and Glu-66 to Thr-74.

Table 2  
*S. pneumoniae* Antigenic Epitopes

**SP063**

Ile-10 to Val-25; Val-30 to Thr-40; Asp-44 to Pro-54; Asn-57 to Val-63; Pro-71 to Val-100; and Thr-105 to Thr-116.

**SP064**

Pro-12 to Leu-32; Val-40 to Leu-68; Asp-95 to Ala-125; Ser-154 to Glu-184; Ser-314 to Glu-346; Asn-382 to Val-393; Leu-463 to Gln-498; Asn-534 to Lys-548; and Lys-557 to Gly-605.

**SP065**

Asn-2 to Ile-12; Ala-39 to Thr-61; and His-135 to Ala-155.

**SP067**

Gly-1 to Thr-13; Asp-203 to Asn-218; and Gly-240 to Asp-253.

**SP068**

Ser-2 to Ser-12; Val-17 to Gln-26; and Lys-54 to Cys-67.

**SP069**

Ser-32 to Thr-41; Pro-66 to Glu-80; Thr-110 to Val-122; and Val-147 to Thr-180.

**SP070**

Lys-6 to Tyr-16; Gln-19 to Ile-27; Arg-50 to Ala-58; Leu-112 to Val-128; Ile-151 to Asn-167; Leu-305 to Phe-321.

**SP071**

Gln-92 to Asn-158; Gln-171 to Gln-188; Val-204 to Val-240; Thr-247 to Ala-273; Glu-279 to Thr-338; Pro-345 to Glu-368; Asn-483 to Lys-539; Val-552 to Ala-568; Glu-575 to Ser-591; Ser-621 to Gly-640; Gln-742 to Gly-758.

**SP072**

Val-68 to Tyr-81; Tyr-86 to Val-121; Leu-127 to Gly-140; Gly-144 to Ala-155; Gln-168 to Val-185; Asp-210 to Thr-241; Glu-246 to Thr-269; Lys-275 to Tyr-295; Gly-303 to Pro-320; Arg-327 to Ile-335; Thr-338 to Thr-364; Tyr-478 to Phe-495; and Tyr-499 to Arg-521.

**SP073**

Glu-37 to Val-45; Glu-55 to Val-68; Thr-104 to Thr-119; Ile-127 to Tyr-135; Asn-220 to Ile-232; Thr-237 to Ala-250; Ser-253 to Ala-263; Glu-284 to Ile-297; and Met-438 to Asn-455.

**SP074**

Gly-2 to Ala-12; Gly-96 to Ile-110; and Thr-220 to Phe-239.

**SP075**

Phe-33 to Tyr-42; Gln-93 to Gly-102; and Val-196 to Asp-211.

**SP076**

Ser-64 to Leu-76; and Phe-81 to Ala-101.

**SP077**

Asp-1 to Glu-12; Tyr-26 to Val-36; and Val-51 to Thr-62.

Table 2  
*S. pneumoniae* Antigenic Epitopes

**SPO78**

Ala-193 to Ile-208; Tyr-266 to Asn-275; Glu-356 to Leu-369; Ala-411 to Gly-422; Ser-437 to Pro-464; Thr-492 to Glu-534; and Glu-571 to Gln-508.

**SPO79**

Gly-11 to Leu-20; Lys-39 to Leu-48; Leu-72 to Val-85; Asn-147 to Ser-158; Ile-178 to Asp-187; Tyr-189 to Gln-201; and Leu-203 to Ala-216

**SPO80**

Ser-2 to Glu-12; Gln-42 to Ala-51; Ala-116 to Ser-127; Phe-131 to Asp-143; and Ile-159 to Ile-171.

**SPO81**

Gln-2 to Leu-9; Gln-49 to Cys-57; Ile-108 to Val-131; Gly-134 to Leu-145; and Trp-154 to Cys-162.

**SPO82**

Ile-101 to Ser-187; Gly-191 to Asn-221; Arg-225 to Arg-236; Tyr-239 to Leu-255; and Gly-259 to Arg-268.

**SPO83**

Ser-28 to Asp-70.

**SPO84**

Leu-42 to Gln-66; Thr-69 to Lys-81; Glu-83 to Arg-92; and Gly-98 to Asn-110.

**SPO85**

Gln-2 to Val-22; and Ser-45 to Glu-51.

**SPO86**

Leu-18 to Gln-65; and Lys-72 to Val-83.

**SPO87**

Ser-45 to Leu-53; and Thr-55 to Gln-63

**SPO88**

Pro-8 to Ile-16; Leu-25 to Trp-33; Tyr-35 to Gln-43; Leu-51 to Val-59; Val-59 to Arg-67; Thr-55 to Tyr-63; Asn-85 to Gly-93; Thr-107 to Leu-115; Leu-115 to Trp-123; Ala-121 to Thr-129; Tyr-153 to Ala-161; His-176 to Gly-184; Tyr-194 to Ala-202; Ala-217 to Gly-225; and Asn-85 to Gly-93.

**SPO89**

Trp-43 to Ala-51; Gln-68 to Phe-76; Val-93 to Gln-101; Phe-106 to Phe-114; Lys-117 to Lys-125; Trp-148 to Phe-156; Glu-168 to Gln-176; Ile-193 to Tyr-201; Lys-203 to Lys-211; Glu-212 to Gln-220; Ile-237 to Tyr-245; Lys-247 to Lys-255; Glu-256 to Gln-264; Met-275 to Gly-283; Lys-286 to Gly-294; Trp-292 to Glu-300; Asp-289 to Thr-297; Tyr-315 to Ser-323; Asp-334 to Lys-342; Pro-371 to Arg-379; Arg-485 to Asn-493; Lys-527 to Arg-535; Phe-537 to Met-545; and Tyr-549 to Glu-557.

**SPO90**

Table 2

*S. pneumoniae* Antigenic Epitopes

Phe-2 to Gln-10; Gln-13 to Lys-21; Tyr-19 to Glu-27; Tyr-39 to Met-47; Pro-65 to Leu-73; Tyr-121 to His-129; Lys-147 to Ile-155; Gly-161 to Lys-169; Gly-218 to Trp-226; Asp-230 to Thr-238; Tyr-249 to Ala-257; and Ala-272 to Gly-280.

**SP091**

Ser-19 to Ser-27; Asn-25 to Thr-33; Val-51 to Gln-59; Asn-75 to Asn-83; Ile-103 to Trp-111; Tyr-113 to Ala-121; Leu-175 to Asn-183; Glu-185 to Trp-193; Ala-203 to Tyr-211; Val-250 to Phe-258; Asn-260 to Thr-268; Ser-278 to Asp-286; Tyr-305 to Leu-313; Asn-316 to Gly-324; Asn-374 to Asp-382; Asn-441 to Gly-449; and Ser-454 to Gln-462.

**SP092**

Arg-95 to Glu-103; Ala-216 to Val-224; Leu-338 to Glu-346; Pro-350 to Ala-358; Pro-359 to Ala-367; Pro-368 to Ala-376; Pro-377 to Ala-385; Pro-386 to Ala-394; Pro-395 to Ala-403; Pro-350 to Ala-358; Gln-414 to Lys-422; Pro-421 to Asn-429; Trp-465 to Tyr-473; Phe-487 to Tyr-495; Asn-517 to Gly-525; Trp-586 to Tyr-594; Phe-608 to Tyr-616; and Asp-630 to Gly-638.

**SP093**

Gln-30 to Ile-38; Gln-52 to Val-60; Ala-108 to His-116; Tyr-133 to Glu-141; Tyr-192 to Ala-200; and Phe-207 to Ser-215.

**SP094**

Ala-87 to Val-95; Leu-110 to Cys-118; Gln-133 to Leu-141; Ser-185 to Leu-193; Ile-195 to Gly-203; Asp-206 to Gln-214; Ser-211 to Gly-219; Ile-241 to Thr-249.

**SP095**

Arg-1 to Gln-9; Phe-7 to Asn-15; Thr-21 to Asn-30; Leu-46 to Phe-54; and Ser-72 to Met-80.

**SP096**

Gly-29 to Ile-37; Glu-52 to Ser-60; and Leu-64 to Gly-72.

**SP097**

Ala-11 to Thr-19; Glu-53 to Glu-61; Ser-91 to Lys-99; Thr-123 to Gln-131; and Gly-209 to Lys-217.

**SP098**

Thr-3 to Ser-11; Gly-38 to Phe-46; Tyr-175 to Asn-183; Met-187 to Cys-195; Gln-197 to Leu-205; Tyr-307 to Gln-315; Gly-318 to Tyr-326; Asn-348 to Val-356; Lys-377 to Pro-385; and Leu-415 to Val-423.

**SP099**

Arg-19 to Gly-27; Asp-76 to Ser-84; Val-90 to Lys-98; Phe-165 to Val-173; Leu-237 to Pro-245.

**SP100**

His-111 to Gln-119; Ser-141 to His-149; Asp-154 to Ser-162; Gln-158 to Gln-166; Asp-154 to Gln-166; Lys-180 to Gln-188; and Ser-206 to Gln-214.

**SP101**



Table 2

*S. pneumoniae* Antigenic Epitopes

Glu-23 to Glu-31; Glu-40 to Val-48; Gln-50 to Ser-58; Thr-61 to Ile-69; Leu-82 to Ile-90; Ala-108 to Leu-116; Gln-121 to Pro-129; and Leu-130 to Thr-138.

**SP102**

Asp-32 to His-40; Arg-48 to Lys-56; and Asp-102 to Thr-110.

**SP103**

Arg-5 to Gln-13; Gln-22 to Leu-30; Arg-151 to Gln-159; Arg-167 to Gln-175; Pro-189 to Glu-197; Gly-207 to Leu-215; Ser-219 to Gln-227; Ser-233 to Ser-241; Pro-255 to Asp-264; Lys-272 to Gly-280; Ser-318 to Val-326; Thr-341 to Asp-351; Asn-356 to Thr-364; Val-370 to Tyr-378; Ile-379 to Gln-387; and Met-435 to Tyr-443.

**SP105**

Asn-28 to Pro-36; Thr-77 to Phe-85; Arg-88 to Val-96; Gly-107 to Phe-115; Asp-169 to Asp-177; His-248 to Ser-256; and Ser-274 to Ala-282.

**SP106**

Val-10 to Thr-18; Ile-62 to Tyr-70; Ile-71 to Pro-79; Lys-86 to Gln-94; Lys-100 to Thr-108; Phe-132 to Leu-140; and Asp-145 to Arg-153.

**SP107**

Asp-33 to Val-41; and Arg-63 to Gln-71.

**SP108**

Lys-9 to Gln-17; Leu-44 to Ser-52; Ser-63 to Phe-71; Tyr-109 to Ser-117; Ile-183 to Ile-191; Pro-194 to Leu-202; Gly-257 to Gln-265; Ala-323 to Thr-331; and Leu-381 to Tyr-389.

**SP109**

Asn-2 to Gln-10; Ala-65 to Lys-73; Leu-76 to Glu-84; Thr-111 to Asp-119; Gln-116 to Tyr-124; Tyr-130 to Val-138; Asp-173 to Gly-181; Asp-196 to Ser-204; Asn-231 to Ser-239; Phe-252 to Ser-260; Phe-270 to Tyr-278; Val-291 to His-299; Asp-306 to Leu-314; and Pro-327 to Gly-335.

**SP110**

Ser-8 to Glu-16; Ile-37 to Val-45; Ala-107 to Val-115; and Gly-122 to Thr-130.

**SP111**

Asp-19 to Glu-28; Leu-43 to Ala-51; Asn-102 to Phe-110; Gln-133 to Ser-141; Phe-162 to Asp-170; Tyr-194 to Met-202; and Asp-273 to Ser-281.

Table 2  
*S. pneumoniae* Antigenic Epitopes

**SP112**

Asp-3 to Gln-11; Gly-21 to Ile-29; Ala-46 to Arg-54; Arg-98 to Arg-106; Thr-114 to Val-122; Gln-133 to Asn-141; and Leu-223 to Thr-231.

**SP113**

Asn-19 to Gly-27; Arg-54 to Ser-62; Val-69 to Gln-77; Ser-117 to Asn-125; Gly-164 to Leu-172; Tyr-193 to Ser-201; Cys-303 to Phe-311; His-315 to Ile-323; Arg-341 to Cys-349; Ile-347 to Ser-355; Arg-403 to Phe-411; Gln-484 to Pro-492; Ser-499 to Leu-507; Ile-541 to Thr-549  
Asn-622 to Ile-630; and Glu-645 to Gly-653.

**SP114**

Gly-17 to Leu-25; His-40 to Gln-48; Arg-49 to Arg-57; Ile-65 to Pro-73;  
Asn-101 to Asp-111; Gly-128 to Cys-136; Phe-183 to Thr-191; and Pro-268 to Ile-276.

**SP115**

Met-8 to Ser-16; Tyr-24 to Leu-32; Cys-68 to Leu-76; Ser-100 to Pro-108; Thr-193 to Thr-201; Gly-238 to Pro-250; Thr-280 to Phe-288; Pro-303 to Asn-312; Trp-319 to Leu-328; Leu-335 to Leu-344; Lys-395 to Ala-403; Asn-416 to Gln-424; Tyr-430 to Ser-438; Val-448 to Leu-456; Leu-460 to Thr-468; Pro-502 to Thr-510; Lys-515 to Ile-524; Gln-523 to His-532; Tyr-535 to Thr-543; Ser-559 to Pro-567; Thr-572 to Asn-580;  
Val-594 to Arg-602; Arg-603 to Asn-611; Thr-620 to Trp-628; and Tyr-644 to Arg-653.

**SP117**

Ala-6 to Gly-14; Ile-19 to Thr-27; Thr-99 to Leu-107; Ser-117 to Asp-125; His-131 to Val-139; Ile-193 to Gly-201; and Val-241 to Gln-249.

**SP118**

Ser-8 to Trp-23; His-46 to Ala-54; Asn-93 to Gly-101; Val-100 to Ser-108; Arg-155 to Asp-163; and His-192 to Leu-200.

**SP119**

Tyr-46 to Lys-54; Ser-93 to Ser-101; Trp-108 to Asn-116; Val-121 to Glu-129; and Tyr-131 to Gln-139.

**SP120**

Ala-57 to Lys-65; Leu-68 to Glu-76; Thr-103 to Tyr-116; Tyr-122 to Val-130; His-163 to Gly-173; Asp-188 to Ser-196; Ser-222 to Ser-231; Phe-244 to Ser-252; Pro-262 to Tyr-270; Val-283 to His-291; and Asp-298 to Leu-306.

**SP121**

Ser-3 to Ala-11; Asp-13 to Leu-21; Ser-36 to Val-44; and Gln-136 to Met-144.

**SP122**

Asn-28 to Lys-36; Glu-39 to Thr-50; Val-54 to Lys-62; Asn-106 to Leu-114; Phe-159 to Gly-167; Asn-172 to Arg-180; Glu-199 to Asn-207;

Table 2  
*S. pneumoniae* Antigenic Epitopes

Lys-230 to His-241; Asn-252 to Gly-263; Met-278 to Ala-287; Thr-346 to Asp-354; Lys-362 to Thr-370; Asp-392 to Asn-405; Asp-411 to Ala-424; Gly-434 to Gly-443; Tyr-484 to Glu-492; Ile-511 to Leu-519; Asn-524 to Asp-538; Glu-552 to Ile-567; Val-605 to Lys-613; Phe-697 to Ala-705; Phe-722 to Leu-730; Leu-753 to Leu-761; Asp-787 to Gln-795; Leu-858 to Asn-866; Ala-892 to Thr-901; Gly-903 to Ile-913; Ile-921 to Asn-931; Asn-938 to Pro-951; Gly-960 to Lys-970; Leu-977 to Asp-985; and Leu-988 to Pro-996.

**SP123**

Val-4 to Asn-12; Glu-47 to Leu-55; Lys-89 to Glu-100; Ser-165 to Thr-173; Lys-234 to Val-242; Ser-258 to Ser-266; Glu-284 to Asn-292; Tyr-327 to Leu-335; Tyr-457 to Thr-465; Tyr-493 to Glu-501; Thr-506 to Tyr-514; Lys-517 to Thr-525; Asn-532 to Gly-540; and Arg-556 to Glu-564.

**SP124**

Arg-16 to Glu-24; Gln-52 to Arg-60; Asn-69 to Tyr-77; Glu-121 to Asn-129; Ala-134 to Val-142; Thr-151 to Ala-159; Asn-164 to Glu-172; His-181 to His-189; Thr-210 to Ala-218; Ser-244 to Val-252; Phe-287 to Tyr-297; Ser-312 to Thr-323; His-433 to Tyr-441; Ser-445 to Asn-453; Asn-469 to Thr-477; Asn-501 to Asn-509; Gln-536 to Ala-547; and Gln-608 to Asp-621.

**SP125**

Ser-9 to Asp-21; Ala-28 to Leu-36; Asn-49 to Phe-57; Val-137 to Arg-145; Asn-155 to Leu-163; Glu-183 to Asp-191; Gly-202 to Tyr-210; Pro-221 to Asp-229; Phe-263 to Ala-271; Phe-300 to Gln-308; Asp-313 to Glu-321; Asn-324 to Asp-332; Ile-346 to Asn-354; Asp-362 to Lys-370; Met-402 to Gly-410; Gly-437 to Gly-445; Ser-471 to Glu-483; Gly-529 to Asp-537; Gln-555 to Val-563; and Leu-579 to Lys-587.

**SP126**

Leu-22 to Thr-30; Val-65 to Leu-73; and Thr-75 to Asp-83.

**SP127**

Glu-2 to Ala-12; Asp-28 to Thr-36; Val-105 to Thr-113; Lys-121 to Thr-129; Trp-138 to Pro-146; Ser-152 to Ile-160; Lys-180 to Asp-188; Leu-194 to Asn-202; and Gly-228 to Thr-236.

Table 3  
*S. pneumoniae* ORF Cloning Primers

Primer Name	SEQ ID	Sequence	RE
SP001A	NO: 227	GACTGGATCCTAAAAATCTACGACAATAAAAAATC	Bam HI
SP001B	NO: 228	CTGAGTCGACTGGTTGTGCTGGTTGAG	Sal I
SP004A	NO: 229	GTCAGGATCCAAATTACAATACGGACTATG	Bam HI
SP004B	NO: 230	CAGTGTGCTGACTAATCTAGGTCGGAAAC	Sal I
SP006A	NO: 231	GACTGGATCCTGAGAATCAAGCTACACCCAAAGAG	Bam HI
SP006B	NO: 232	AGTCAAGCTTTTGTAACTGAGATTGATCTGG	Hind III
SP007A	NO: 233	GACTGGATCCTGGTAACCGCTCTTCTCGTAACGCAGC	Bam HI
SP007B	NO: 234	AGTCAAGCTTTTTCAGGAACCTTTTACGCTTCC	Hind III
SP008A	NO: 235	AGTCAGATCTTGTGAAAATTGACAGGTAACAGCAAAAAAGCTGC	Bgl II
SP008B	NO: 236	ACTGAAGCTTTTTTGTCTTTTCAAGAATTCATCG	Hind III
SP009A	NO: 237	GACTGGATCCTGGTCAAGGAACCTGCTTCTAAAGAC	Bam HI
SP009B	NO: 238	AGTCAAGCTTTTCACAAATTCGTTGGTGAAGCC	Hind III
SP010A	NO: 239	GACTGGATCCTAGCTCAGGTGGAACGCTGGTTCATCC	Bam HI
SP010B	NO: 240	AGTCAAGCTTATCAACTTTTCCACCTTCAACAACC	Hind III
SP011A	NO: 241	GTCAAGATCTCTCCAACTATGGTAAATCTGCGGATGG	Bgl II
SP011B	NO: 242	AGTCCTGCAGATCCACATCCGCTTTCATCGGGTTAAAGAAGG	Pst I
SP012A	NO: 243	GACTGGATCCTGGGAAAAATCTAGCGAAACTAGTGG	Bam HI
SP012B	NO: 244	GTCAGTGCAGCTGTCCTTCTTTTACTTCTTTGGTTGC	Pst I
SP013A	NO: 245	GACTGGATCCTGCTAGCGGAAAAAAGATACAACCTTCTGG	Bam HI
SP013B	NO: 246	CTGAAAGCTTTTTTGGCAATCCTTCAGCAATCTTGTC	Hind III
SP014A	NO: 247	GACTAGATCTTGGCTCAAAAAATACAGCTTCAAGTCC	Bgl II
SP014B	NO: 248	AGTCCTGCAGGTTTTTGTGTTGCTTGGTATTGGTCG	Pst I
SP015A	NO: 249	GACTGGATCCTAGTACAACTCAAGCACTAGTCAGACAGAG	Bam HI
SP015B	NO: 250	CAGTCTGCAGTTTCAAGCTTTTTGTATGTCTTC	Pst I
SP016A	NO: 251	GACTGGATCCTGGCAATTCTGGCGGAAGTAAAGATGC	Bam HI
SP016B	NO: 252	AGTCAAGCTTGTTTCATAGCTTTTTTGATTGTTTCG	Hind III
SP017A	NO: 253	GACTGGATCCTTCAAGAAAAAACAAAAATGAAGATGG	Bam HI
SP017B	NO: 254	AGTCAAGCTTATCGACGTAGTCTCCGCCCTTC	Hind III
SP019A	NO: 255	GACTGGATCCGAAAGGTCTGTGGTCAAATAATCTTACC	Bam HI
SP019B	NO: 256	AGTCAAGCTTAGAGTTAACAATGGTGTGTTGCCAATAGG	Hind III
SP020A	NO: 257	GACTGGATCCAACTCAGAAAAAGAAAGCAGACAATGC	Bam HI
SP020B	NO: 258	AGTCAAGCTTCCAACTGTTGATCCAAACCATCTG	Hind III
SP021A	NO: 259	GACTGGATCCTTCGAAAGGGTCAGAAAGGTGCAGACC	Bam HI
SP021B	NO: 260	AGTCAAGCTTCTGTAGGCTTGGTGTGCCCCAGTTGC	Hind III
SP022A	NO: 261	CTGAGGATCCGGGGATGGCAGCTTTTTAAAAATC	Bam HI
SP022B	NO: 262	CAGTAAGCTTGTTTACCCATTACCCATTACC	Hind III
SP023A	NO: 263	CAGTGGATCCAGACGAGCAAAAAATTAAG	Bam HI
SP023B	NO: 264	TCAGAAGCTTGTTTACCCATTACCCATT	Hind III
SP025A	NO: 265	GACTGGATCCCTGTGGTGAGGAAGAACTAAAAAG	Bam HI
SP025B	NO: 266	CTGAGTCGACAATATTCTGTAGGAATGCTTCGAATTTG	Sal I
SP028A	NO: 267	CTGAGGATCCGACTTTTAACAATAAACTATTGAAGAG	Bam HI
SP028B	NO: 268	GTCAGTGCAGGTTGTACCTCCAAAAATCACGG	Pst I
SP030A	NO: 269	GACTGGATCCCTTTACAGGTAAACAACACAAAGTCGG	Bam HI
SP030B	NO: 270	CAGTAAGCTTTTTCGAAGTTTGGCTCAGAATTG	Hind III
SP031A	NO: 271	GACTGGATCCCCAGGCTGATACAAGTATCGCA	Bam HI
SP031B	NO: 272	CAGTAAGCTTATCTGCAGTATGGCTAGATGG	Hind III
SP032A	NO: 273	GACTGGATCCGCTCTGTATCATTTGAAAACAAAGAAAC	Bam HI
SP032B	NO: 274	CAGTCTGCAGTTTACTGTTGTCTGTGCTTGTG	Pst I
SP033A	NO: 275	ACTGAGATCTTGGTCAAAAGGAAAGTCAGACAGGAAAGG	Bgl II
SP033B	NO: 276	CAGTAAGCTTATTCCTGAGCTTTTTTGATAAAGGTTGCGCA	Hind III
SP034A	NO: 277	ACTGGGATCCGAAGGATAGATATATTTTAGCATTTGAGAC	Bam HI
SP034B	NO: 278	AGTCAAGCTTCCATGGTATCAAAGGCAAGACTTGG	Hind III
SP035A	NO: 279	GTCAGGATCCGGTAGTTAAAGTTGGTATTAACGG	Bam HI
SP035B	NO: 280	AGTCAAGCTTGCAATTTTGGCAAGTATTTCCAAGAG	Hind III
SP036A	NO: 281	AGTCGGATCCTTCTTACGAGTTGGGACTGTATCAAGC	Bam HI

Table 3

*S. pneumoniae* ORF Cloning Primers

Primer		Sequence	RE
Name	SEQ ID		
SP036B	NO: 282	AGTCAAGCTTGTATTTTTCCTTACTTACAGATGAAGG	Hind III
SP038A	NO: 283	AGTCGGATCCTACTGAGATGCATCATAATCTAGGAGC	Bam HI
SP038B	NO: 284	TCAGCTCGAGTTCTTTGACATCTCCATCATAAGTCGC	Xho I
SP039A	NO: 285	GACTGGATCCGGTTTGTAGAAAGTATTTGCAGGGG	Bam HI
SP039B	NO: 286	CAGTAAGCTTGGATTTTTTCATGGATGCAATTTTTTTGG	Hind III
SP040A	NO: 287	GACTGGATCCGACAACATTACTATCCATACAGTAGAGTCAGC	Bam HI
SP040B	NO: 288	GACTAAGCTTGGCATAAGGTTGCAATTCTGGATTAATTGG	Hind III
SP041A	NO: 289	GACTGGATCCGGCTAAGGAAAGAGTGGATG	Bam HI
SP041B	NO: 290	GACTAAGCTTTTCATTTTTAAATTGACTATGCGCCCCG	Hind III
SP042A	NO: 291	GACTGGATCCTTGTTCCTATGAACCTGGTCGTCACC	Bam HI
SP042B	NO: 292	CATGAAGCTTATCCTGGATTTTTCCAAGTAAATCT	Hind III
SP043A	NO: 293	GACTGGATCCTTATAAGGGTGAATTAGAAAAAGG	Bam HI
SP043B	NO: 294	GACTAAGCTTCTTATTAGGATTGTTAGTAGTTG	Hind III
SP044A	NO: 295	GACTGGATCCGAATGTTCAAGGCTCAAGAAAGTTCAGG	Bam HI
SP044B	NO: 296	GACTAAGCTTTTCCCTGATGGAGCAAAGTAATACC	Hind III
SP045A	NO: 297	GACTGGATCCCTTGGGTGTAACCCATATCCAGCTCCTTCC	Bam HI
SP045B	NO: 298	GACTGTCGACTTCAGCTTGTTTATCTGGGGTTCG	Sal I
SP046A	NO: 299	GACTGGATCCTAGTGATGGTACTTGGCAAGGAAAACAG	Bam HI
SP046B	NO: 300	ACTGCTGCAGATCTTTGCCACCTAGCTTCTCATTG	Pst I
SP048A	NO: 301	GTCAGGATCCTGGGATTCAATATGTCAGAGATGATACTAG	Bam HI
SP048B	NO: 302	CTAGAAGCTTACGCACCCATTCAACCATATCATTG	Hind III
SP049A	NO: 303	GTCAGGATCCGGATAATAGAGAAGCATTAATAAACCC	Bam HI
SP049B	NO: 304	AGTCAAGCTTGACAAAATCTTGAAACTCCTCTGGTC	Hind III
SP050A	NO: 305	GTCAGGATCCAGATTTTGTGCGAGGAGTGCATACC	Bam HI
SP050B	NO: 306	AGTCAAGCTTTCCTTTTACCCTTACGAATCCAGG	Hind III
SP051A	NO: 307	GACTGGATCCATCTGTAGTTTATGCGGATGAAACACTTATTAC	Bam HI
SP051B	NO: 308	GACTGTCGACGCTTTGGTAGAGATAGAAGTCATG	Sal I
SP052A	NO: 309	GACTGGATCCTTACTTTGGTATCGTAGATACAGCCGGC	Bam HI
SP052B	NO: 310	AGTCAAGCTTTGTTAATTGCGTACCTTCTAAGCGACC	Hind III
SP053A	NO: 311	GACTGGATCCAGCTAAGGTTGCATGGGATGCGATTGC	Bam HI
SP053B	NO: 312	GACTGTCGACCTGGGCTTTATTAGTTTGGACTAGC	Sal I
SP054A	NO: 313	CAGTGGATCCCTATCACTATGTAAATAAAGAGA	Bam HI
SP054B	NO: 314	ACTGAAGCTTTTCTGTCCCTGTTTGAGGCA	Hind III
SP055A	NO: 315	CAGTGGATCCTGAGACTCCTCAATCAATAACAAA	Bam HI
SP055B	NO: 316	ACGTAAGCTTATAATCAGTAGGAGAACTGAAC	Hind III
SP056A	NO: 317	CAGTGGATCCGGATGCTCAAGAAACTGCGG	Bam HI
SP056B	NO: 318	GACTAAGCTTTGCTCTCATCTTGTGCTTCC	Hind III
SP057A	NO: 319	CAGTGGATCCCGACAAAGGTGAGACTGAG	Bam HI
SP057B	NO: 320	ACGTAAGCTTATTTCTTAATTCAAGTGTTCCTCTG	Hind III
SP058A	NO: 321	GACTGGATCCAAATCAATTGGTAGCACAAGATCC	Bam HI
SP058B	NO: 322	CAGTGTGACATTAGGAGCCACTGGTCTC	Sal I
SP059A	NO: 323	CAGTGGATCCCAACAGTCAGCTTCAGGAAC	Bam HI
SP059B	NO: 324	GACTCTGCAGTTTAATCTTGTCCAGGTGG	Pst I
SP060A	NO: 325	GACTGGATCCATTGATGATGCGGATGAAAAG	Bam HI
SP060B	NO: 326	GACTAAGCTTCATTTGTCTTTGGGTATTTTCGCA	Hind III
SP062A	NO: 327	CAGTGGATCCCGAGAGTCGATCAAAAGTAG	Bam HI
SP062B	NO: 328	GTCAGTGCAGTTGCTCGTCTCGAGGTTC	Pst I
SP063A	NO: 329	CAGTGGATCCATGGACAACAGGAACTGGGAC	Bam HI
SP063B	NO: 330	CAGTAAGCTTATTAGCTTCTGTACCTGTGTTTG	Hind III
SP064A	NO: 331	GACTGGATCCCGATGGGCTCAATCCAACCCAGGTCAAGTC	Bam HI
SP064B	NO: 332	GACTCTGCAGCATAGCTTTATCTCTGACATCATCGTATC	Pst I
SP065A	NO: 333	GACTGGATCCTTCCAATCAAAAACAGGCAGATGG	Bam HI
SP065B	NO: 334	GACTAAGCTTGAGTCCCATAGTCCAAGGCA	Hind III
SP067A	NO: 335	AGTCGGATCCTATCACAGGATCGAACGGTAAGACAACC	Bam HI
SP067B	NO: 336	ACTGGTCCGACTTCTTTAACTCCGCTACTGTGTC	Sal I

Table 3  
*S. pneumoniae* ORF Cloning Primers

Primer			
Name	SEQ ID	Sequence	RE
SP068A	NO:337	CAGTGGATCCAAGTTTCATCGAAGATGGTTGGGAAGTCC	Bam HI
SP068B	NO:338	GATCGTCGACCCGCTCCACATGCTCAACCTT	Sal I
SP069A	NO:339	TGACGGATCCATCGCTAGCTAGTGAAATGCAAGAAAG	Bam HI
SP069B	NO:340	TGACAAGCTTATTCGTTTTTGAAGTAGTTGCTTTTCGT	Hind III
SP070A	NO:341	GACTGGATCCGCACCAGATGGGGCACAAGGTTTCAGGG	Bam HI
SP070B	NO:342	TGACAAGCTTAACTTGTAAACGAACAGTTCAATCTG	Hind III
SP071A	NO:343	GACTAGATCTTTTAAACCCAACTGTTGGTACTTTCC	Bgl II
SP071B	NO:344	TGACAAGCTTGTAGGTGTTACATTTTGACCGTC	Hind III
SP072A	NO:345	ACTGAGATCTTTTAAACCCAACTGTTGGTACTTTC	Bgl II
SP072B	NO:346	GACTAAGCTTTCTACGATAACGATCATTTTCTTTACC	Hind III
SP073A	NO:347	GACTGTCGACTCGTAGATATTTAAGTCTAAGTGAAGCG	Sal I
SP073B	NO:348	AGTCAAGCTTGTAGGTGTTACATTTTGCAAGTC	Hind III
SP074A	NO:349	GACTGGATCCCTTTGGTTTTGAAGGAAGTAAG	Bam HI
SP074B	NO:350	TGACCTGCAGACGATTTTTGAAAAATGGAGGTGTATC	Pst I
SP075A	NO:351	CAGTGGATCCCTACTACCTCTCGAGAGAAAG	Bam HI
SP075B	NO:352	ACTGAAGCTTTTCGCTTTTACTCGTTTGACA	Hind III
SP076A	NO:353	CAGTGGATCCCTAAGGTCAAAAGTCAGACCGCTAAGAAAGTGC	Bam HI
SP076B	NO:354	CAGTAAGCTTTAGGGTATCCAAATACTGTTGTTGATG	Hind III
SP077A	NO:355	TGACAGATCTTGACGGGTCTCAGGATCAGACTCAGG	Bgl II
SP077B	NO:356	TGACAAGCTTCAAAGACATCCACCTCTTGACCTTTG	Hind III
SP078A	NO:357	GACTGGATCCTAGAGGCTTTGCCAAATGGTGGGAAGGG	Bam HI
SP078B	NO:358	GTCAGTCGACTTGTGTAAACACTTTTCGAGGTTTGGTACC	Sal I
SP079A	NO:359	CAGTGGATCCCTCAAAAAGAGAAGGAAAACCTTGG	Bam HI
SP079B	NO:360	CAGTCTGCAGTTTCTTCAACAAACCTTGTCTTG	Pst I
SP080A	NO:361	CAGTGGATCCACGTTCTATTGAGGACCACTT	Bam HI
SP080B	NO:362	CAGTAAGCTTTTCTTCTCAGTCAATTCTTTTCC	Hind III
SP081A	NO:363	GACTGGATCCCGCTCAAAATACCAGAGGTGTTTCAG	Bam HI
SP081B	NO:364	GACTAAGCTTAGTACCATTGGGTGTGACAGGTTTGAA	Hind III
SP082A	NO:365	CTGAGGATCCAATTGTACAATTAGAAAAAGATAGC	Bam HI
SP082B	NO:366	TGACAAGCTTGCGTTGACTAGGTTCTGCAATGCC	Hind III
SP083A	NO:367	GACTGGATCCTCTGACCAAGCAAAAAGAAGCAGTCAATGA	Bam HI
SP083B	NO:368	TCAGCAGCTGATCATTGACTTTACGATTTGCTCC	Bgl II
SP084A	NO:369	GACTGGATCCGTCGGCTCTGTCCAGTCCACTTTTTCAGCG	Bam HI
SP084B	NO:370	TCAGAAGCTTATTTTGTGTTTCTTAATGCGTT	Hind III
SP085A	NO:371	GACTGGATCCGGGACAAATTCAAAAAATAGGCAAGAGG	Bam HI
SP085B	NO:372	GTCAAAGCTTTGGCTCTTTGATTGCCAACCACTG	Hind III
SP086A	NO:373	GACTGGATCCTCGCTACCAGCAACAAAGCGAGCAAAAGG	Bam HI
SP086B	NO:374	GACTAAGCTTACTTTTTCTTTTCCACACGA	Hind III
SP087A	NO:375	CAGTGGATCCGAACCGACAAGTCGCCCACTATCAAGACT	Bam HI
SP087B	NO:376	CTGAAAGCTTTGAATTCTCTTTTCTTTTTCAGGCT	Hind III
SP088A	NO:377	TCGAGGATCCGGTTGTGCGCTGGCAATATATCCCGT	Bam HI
SP088B	NO:378	CAGTAAGCTTCCGAACCCATTGCGCAATTATAGTTGAC	Hind III
SP089A	NO:379	AGTCGGATCCGGCCAAATCAGAATGGGTAGAAGAC	Bam HI
SP089B	NO:380	TGACCTGCAGCTTCTCATTGATTTTCATCATCAC	Pst I
SP090A	NO:381	GACTGGATCCATTGTCAGATGATTCTGAAGGATGG	Bam HI
SP090B	NO:382	TCAGCTGCAGCTTAACCCATTACCAATTCTAGTTTAAG	Pst I
SP091A	NO:383	GACTGGATCCTGTGCTGCTGCAAAATGAAACTGAAGTAGC	Bam HI
SP091B	NO:384	GACTAAGCTTATACCAAAACGCTGACATCTACGCG	Hind III
SP092A	NO:385	AGTCAGATCTTACGTCTCAGCCTACTTTTGAAGAGC	Bgl II
SP092B	NO:386	GACTAAGCTTAACCCATTACCAATTGGCATTGAC	Hind III
SP093A	NO:387	CAGTGGATCCTGGACAGGTGAAAGGTCATGCTACATTGTG	Bam HI
SP093B	NO:388	GACTAAGCTTCAACCAATTGAGACCTTGCAACAC	Hind III
SP094A	NO:389	GTCAGGATCCGATGCTCCTTTTGAAGGATTGAGAGAAACC	Bam HI
SP094B	NO:390	GACTAAGCTTTCGATCAAAAGATAAGATAAATATATAAAGT	Hind III
SP095A	NO:391	GACTGGATCCTAGGTATATGGGACTTTTTTCTACAACAAAATAGG	Bam HI

Table 3  
*S. pneumoniae* ORF Cloning Primers

Primer			
Name	SEQ ID	Sequence	RE
SP095B	NO:392	TGACAAGCTTATCTATCAGCTCATTTAATCGTTTTTG	Hind III
SP096A	NO:393	CTGAGGATCCCAACGTTGAGAATTATTTGCGAATG	Bam HI
SP096B	NO:394	TGACAAGCTTGAGTCTACAAAAGTAATGTAC	Hind III
SP097A	NO:395	GTCAGGATCCCTACTATCAATCAAGTTCTTCAGCC	Bam HI
SP097B	NO:396	TGACAAGCTTGACTGAGGCTTGGACCAGATTGAAAAG	Hind III
SP098A	NO:397	GACTGGATCCGACAAAACATTAAAAACGTCCTGAGG	Bam HI
SP098B	NO:398	GACTAAGCTTAGCACGAACTGTGACGCTGGTTCC	Hind III
SP099A	NO:399	GACTGGATCCTTCTCAGGAGACCTTTAAAAATATC	Bam HI
SP099B	NO:400	GACTAAGCTTGTTGGCCATCTTGACATACC	Hind III
SP100A	NO:401	GACTGGATCCAGTAAATGCGCAATCAAATTC	Bam HI
SP100B	NO:402	AGTCCTGCAGGTATTTAGCCCAATAATCTATAAGCT	Pst I
SP101A	NO:403	CAGTGGATCCTTACCGCGTTCATCAAGATGTC	Bam HI
SP101B	NO:404	GACTAAGCTTGCCAGATGTTGAAAAGAGAGTG	Hind III
SP102A	NO:405	GACTGGATCCGTTGGATGGGCTTTAACTATCTTCGTATTCG	Bam HI
SP102B	NO:406	AGTCAAGCTTGCTAGTCTTCACTTTCCCTTTCC	Hind III
SP103A	NO:407	GACTGTGACACTAAACCAGCATCGTTCGCAGGA	Sal I
SP103B	NO:408	CTGACTGCAGCTTCTTGAAGAAATAATGATTGTGG	Pst I
SP105A	NO:409	CAGTGGATCCTGACTACCTTGAAATCCCACTT	Bam HI
SP105B	NO:410	CAGTAAGCTTTTTTTTAAAGTTGTAGAATGATTCAATC	Hind III
SP106A	NO:411	CAGTGTGACTCGTATCTTTTTTTGGAGCAATGTT	Sal I
SP106B	NO:412	GACTAAGCTTAAATGTTCCGATACGGGTGATTG	Hind III
SP107A	NO:413	CAGTGGATCCGGACTCTCTCAAAGATGTGAAAAG	Bam HI
SP107B	NO:414	GACTAAGCTTCTTGAGTTGTCAAGGATTGCTTT	Hind III
SP108A	NO:415	CAGTGGATCCCAAGAAATCCTATCATCTCTCCAGAAG	Bam HI
SP108B	NO:416	GACTAAGCTTTTTCAGAACTAAAAGCCGACGCTT	Hind III
SP109A	NO:417	GACTGGATCCACGAAATGCAGGGCAGACAG	Bam HI
SP109B	NO:418	CAGTAAGCTTATCAACATAATCTAGTAAATAAGCGT	Hind III
SP110A	NO:419	CAGTGGATCCTGTATAGTTTTTAGCGCTTGTCTTTC	Bam HI
SP110B	NO:420	GTCAAAGCTTTGTAGAGTGTCAATATCTCTTTAG	Hind III
SP111A	NO:421	GACTGGATCCGTTGTGTCGAGCATATTCTGAAG	Bam HI
SP111B	NO:422	CAGTAAGCTTACTTTTACCATTCTTTGTTCTGCATC	Hind III
SP112A	NO:423	GACTGTGACGTTTGGATAGCATTACAGATCAGACG	Sal I
SP112B	NO:424	CAGTAAGCTTCGGAAGTAAAGACAATTTTTC	Hind III
SP113A	NO:425	CAGTGGATCCGTCCTAGATAGTATTATTACTCAAAC	Bam HI
SP113B	NO:426	GACTAAGCTTTTTGCTTATTTCTCTCAATTTTTC	Hind III
SP114A	NO:427	CAGTGGATCCCATTCAGAAGCAGACCTATCAAATC	Bam HI
SP114B	NO:428	ACTGAAGCTTATGTAATTTTGTAGATTTTCAATATTTTTCAG	Hind III
SP115A	NO:429	AGTCGGATCCCTAAGGCTGATAATCGTGTTCAAATG	Bam HI
SP115B	NO:430	GACTAAGCTTAAATTAGATAGACGTTGAGT	Hind III
SP117A	NO:431	AGTCGGATCCCTGTGGCAATCAGTCAGCTGCTTCC	Bam HI
SP117B	NO:432	GACTGTGCACTTTAATCTTGTCACGAGTGTTAATTTGCC	Sal I
SP118A	NO:433	ACTGGTCACTTGTCAACAACAACATGCTACTTCTGAG	Sal I
SP118B	NO:434	GACTCTGCAGAAAGTTAACCACCTTATCATTATCC	Pst I
SP119A	NO:435	ACTGGATCCTTGTTTCAGGCAAGTCCGTGACTAGTGAAC	Bam HI
SP119B	NO:436	GACTAAGCTTGGCTAATTCCTTCAAAGTTTGCA	Hind III
SP120A	NO:437	AGTCGGATCCCTCGCAAATTGAAAAGCGGCAGTTAGCC	Bam HI
SP120B	NO:438	GACTAAGCTTGTAATAAAGCGTACCTTTTCTTCC	Hind III
SP121A	NO:439	TCAGGGATCCTTGTCACTCAGGTTCTAATGGTTCTCAG	Bam HI
SP121B	NO:440	AGTCAAGCTTGGCATTGGCGTCGCCGCTCTTC	Hind III
SP122A	NO:441	GACTGGATCCGAAACTTCACAGGATTTTAAAGAGAAG	Bam HI
SP122B	NO:442	GACTGTGACAATCAATCCTTCTTCTGCACTTCT	Sal I
SP123A	NO:443	CAGTGGATCCTGTGGTCAAGTTGAGACTCCTCAATC	Bam HI
SP123B	NO:444	GACTAAGCTTTTCTTCAAATTTATTATCAGC	Hind III
SP124A	NO:445	AGTCGGATCCAACACCTGTATATAAAGTTACAGCAATCG	Bam HI
SP124B	NO:446	GACTGTGCACTACTTGACCGAATGCGTCGAATGTACG	Sal I

Table 3

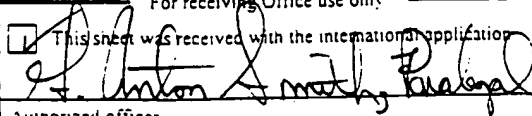
*S. pneumoniae* ORF Cloning Primers

Primer			
<u>Name</u>	<u>SEO ID</u>	<u>Sequence</u>	<u>RE</u>
SP125A	NO:447	CTGAGGATCCATTAGACAGATTAATTGAAATCGG	Bam HI
SP125B	NO:448	GACTGTCGACTTTAAAGATTGAAGTTTAAAGCT	Sal I
SP126A	NO:449	TGACGGATCCTAAGACAGATGAACGGAGCAAGGTG	Bam HI
SP126B	NO:450	CTGAAAGCTTTAAGGCTTCCTCAATGAGTTTGTCT	Hind III
SP127A	NO:451	GACTGGATCCCTGTGAGAATCAAGCTACACCCA	Bam HI
SP127B	NO:452	CTGAAAGCTTTGTAACTGAGATTGATCTGGGAG	Hind III



## INDICATIONS RELATING TO A DEPOSITED MICROORGANISM

(PCT Rule 13bis)

A. The indications made below relate to the microorganism referred to in the description on page <u>9</u> , line <u>12</u>	
B. IDENTIFICATION OF DEPOSIT <span style="float: right;">Further deposits are identified on an additional sheet: <input type="checkbox"/></span>	
Name of depositary institution <b>American Type Culture Collection</b>	
Address of depositary institution (including postal code and country) <b>12301 Parklawn Drive Rockville, Maryland 20852 United States of America</b>	
Date of deposit <b>October 10, 1996</b>	Accession Number <b>55840</b>
C. ADDITIONAL INDICATIONS (leave blank if not applicable) <span style="float: right;">This information is continued on an additional sheet: <input checked="" type="checkbox"/></span>	
In respect of those designations in which a European Patent is sought a sample of the deposited microorganism will be made available until the publication the mention of the grant of the European patent or until the date on which application has been refused or withdrawn or is deemed to be withdrawn, only by the issue of such a sample to an expert nominated by the person requesting the sample (Rule 28(4) EPC).	
D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE (if the indications are not for all designated States)	
E. SEPARATE FURNISHING OF INDICATIONS (leave blank if not applicable)	
The indications listed below will be submitted to the International Bureau later (specify the general nature of the indications e.g., "Accession Number of Deposit")	
<div>For receiving Office use only</div> <div><input checked="" type="checkbox"/> This sheet was received with the international application</div> <div></div> <div>Authorized officer:</div> <div><b>12 DECEMBER 1997</b></div>	<div>For International Bureau use only</div> <div><input type="checkbox"/> This sheet was received by the International Bureau on:</div> <div>Authorized officer:</div>

Form PCT/RO/134 (July 1992)

**SINGAPORE**

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for international publication of the application.

**NORWAY**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Norwegian Patent Office), or has been finally decided upon by the Norwegian Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Norwegian Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Norwegians Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Norwegian Patent Office or any person approved by the applicant in the individual case.

**AUSTRALIA**

The applicant hereby gives notice that the furnishing of a sample of a microorganism shall only be effected prior to the grant of a patent, or prior to the lapsing, refusal or withdrawal of the application, to a person who is a skilled addressee without an interest in the invention (Regulation 3.25(3) of the Australian Patents Regulations).

**FINLAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the National Board of Patents and Registration), or has been finally decided upon by the National Board of Patents and Registration without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art.

**ICELAND**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Icelandic Patent Office), or has been finally decided upon by the Icelandic Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected in the art.

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**DENMARK**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Danish Patent Office), or has been finally decided upon by the Danish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the Danish Patent Office not later than at the time when the application is made available to the public under Sections 22 and 33(3) of the Danish Patents Act. If such a request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Danish Patent Office or any person approved by the applicant in the individual case.

**SWEDEN**

The applicant hereby requests that, until the application has been laid open to public inspection (by the Swedish Patent Office), or has been finally decided upon by the Swedish Patent Office without having been laid open to public inspection, the furnishing of a sample shall only be effected to an expert in the art. The request to this effect shall be filed by the applicant with the International Bureau before the expiration of 16 months from the priority date (preferably on the Form PUT/RO/134 reproduced in annex Z of Volume I of the PCT Applicant's Guide). If such a request has been filed by the applicant, any request has been filed by the applicant, any request made by a third party for the furnishing of a sample shall indicate the expert to be used. That expert may be any person entered on a list of recognized experts drawn up by the Swedish Patent Office or any person approved by the applicant in the individual case.

**UNITED KINGDOM**

The applicant hereby requests that the furnishing of a sample of a microorganism shall only be made available to an expert. The request to this effect must be filed by the applicant with the International Bureau before the completion of the technical preparations for the International publication of the application.

**NETHERLANDS**

The applicant hereby requests that until the date of a grant of a Netherlands patent or until the date on which the application is refused or withdrawn or lapse, the microorganism shall be made available as provided in Rule 31F(1) of the Patent Rules only by the issue of a sample to an expert. The request to this effect must be furnished by the applicant with the Netherlands Industrial Property Office before the date on which the application is made available to the public under Section 22C or Section 25 of the Patents Act of the Kingdom of the Netherlands, whichever two dates occurs earlier.

*What Is Claimed Is:*

1. An isolated nucleic acid molecule comprising a polynucleotide having a nucleotide sequence at least 95% identical to a sequence selected from the group consisting of:
- 5 (a) a nucleotide sequence encoding any of the amino acid sequences of the polypeptides shown in Table 1; or
- (b) a nucleotide sequence complementary to any of the nucleotide sequences in (a).
- 10 2. An isolated nucleic acid molecule comprising a polynucleotide which hybridizes under stringent hybridization conditions to a polynucleotide having a nucleotide sequence identical to a nucleotide sequence in (a) or (b) of claim 1 wherein said polynucleotide which hybridizes does not hybridize under
- 15 stringent hybridization conditions to a polynucleotide having a nucleotide sequence consisting of only A residues or of only T residues.
3. An isolated nucleic acid molecule comprising a polynucleotide which encodes the amino acid sequence of an epitope-bearing portion of a polypeptide having an amino acid sequence in (a) of claim 1.
- 20 4. The isolated nucleic acid molecule of claim 3, wherein said epitope-bearing portion of a polypeptide has an amino acid sequence listed in Table 2.
- 25 5. A method for making a recombinant vector comprising inserting an isolated nucleic acid molecule of claim 1 into a vector.
6. A recombinant vector produced by the method of claim 5.
- 30 7. A method of making a recombinant host cell comprising introducing the recombinant vector of claim 6 into a host cell.
8. A recombinant host cell produced by the method of claim 7.
- 35 9. A method of producing a polypeptide encoded by the nucleic acid molecule of claim 1 comprising culturing the host cell of claim 8 under conditions favoring expressing the heterologous polypeptide.

10. A polypeptide produced according to the method of claim 9.
11. An isolated polypeptide comprising an amino acid sequence at  
5 least 70% identical to a sequence selected from the group consisting of an amino acid sequence of any of the polypeptides described in Table 1.
12. An isolated polypeptide antigen comprising an amino acid  
10 sequence of an *S. pneumoniae* epitope shown in Table 2.
13. An isolated nucleic acid molecule comprising a polynucleotide  
with a nucleotide sequence encoding a polypeptide of claim 9.
14. An isolated antibody that binds specifically to a polypeptide of  
15 claim 11.
15. A hybridoma which produces an antibody according to claim 14.
16. A vaccine, comprising:  
20 (1) one of more *S. pneumoniae* polypeptides selected from the group consisting of a polypeptide comprising an amino acid sequence identified in Table 1, or a fragment thereof; and  
(2) a pharmaceutically acceptable diluent, carrier, or excipient;  
wherein said polypeptide is present, in an amount effective to elicit protective  
25 antibodies in an animal to a member of the *Streptococcus* genus.
17. A method of preventing or attenuating an infection caused by a member of the *Streptococcus* genus in an animal, comprising administering to said animal a polypeptide of claim 11, wherein said polypeptide is administered  
30 in an amount effective to prevent or attenuate said infection.
18. A method of detecting *Streptococcus* nucleic acids in a biological sample obtained from an animal involving assaying for one or more nucleic acid sequences encoding *Streptococcus* polypeptides in a sample comprising:  
35 (a) contacting the sample with one or more of the above-described nucleic acid probes, under conditions such that hybridization occurs, and  
(b) detecting hybridization of said one or more probes to the one or more *Streptococcus* nucleic acid sequences present in the biological sample.

19. A method of detecting *Streptococcus* nucleic acids in a biological sample obtained from an animal, comprising:

- 5 (a) amplifying one or more *Streptococcus* nucleic acid sequences in said sample using polymerase chain reaction, and  
(b) detecting said amplified *Streptococcus* nucleic acid.

20. A kit for detecting *Streptococcus* antibodies in a biological sample obtained from an animal, comprising

- 10 (a) a polypeptide of claim 12 attached to a solid support; and  
(b) detecting means.

21. A method of detecting *Streptococcus* antibodies in a biological sample obtained from an animal, comprising

- 15 (a) contacting the sample with a polypeptide of claim 12; and  
(b) detecting antibody-antigen complexes.

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>6</sup> : <b>C12N 15/31, 5/18, 1/21, C07K 14/315, C12Q 1/68, A61K 39/09, G01N 33/569, 33/68</b></p>	<p><b>A3</b></p>	<p>(11) International Publication Number: <b>WO 98/18930</b> (43) International Publication Date: 7 May 1998 (07.05.98)</p>
<p>(21) International Application Number: PCT/US97/19422 (22) International Filing Date: 30 October 1997 (30.10.97) (30) Priority Data: 60/029,960 31 October 1996 (31.10.96) US (71) Applicant (for all designated States except US): HUMAN GENOME SCIENCES, INC. [US/US]; 9410 Key West Avenue, Rockville, MD 20850 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): KUNSCH, Charles, A. [US/US]; 2398B Dunwoody Crossing, Atlanta, GA 30338 (US). CHOI, Gil, H. [KR/US]; 11429 Potomac Oaks Drive, Rockville, MD 20850 (US). JOHNSON, L., Sydnor [US/US]; 13545 Ambassador Drive, Germantown, MD 20874 (US). HROMOCKYJ, Alex [US/US]; 10003 Sidney Road, Silver Spring, MD 20901 (US). (74) Agents: BROOKES, A., Anders et al.; Human Genome Sciences, Inc., 9410 Key West Avenue, Rockville, MD 20850 (US).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report: 8 October 1998 (08.10.98)</p>
<p>(54) Title: <i>STREPTOCOCCUS PNEUMONIAE</i> ANTIGENS AND VACCINES</p> <p>(57) Abstract</p> <p>The present invention relates to novel vaccines for the prevention or attenuation of infection by <i>Streptococcus pneumoniae</i>. The invention further relates to isolated nucleic acid molecules encoding antigenic polypeptides of <i>Streptococcus pneumoniae</i>. Antigenic polypeptides are also provided, as are vectors, host cells and recombinant methods for producing the same. The invention additionally relates to diagnostic methods for detecting <i>Streptococcus</i> nucleic acids, polypeptides and antibodies in a biological sample.</p>		

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## INTERNATIONAL SEARCH REPORT

Intern. Application No  
PCT/US 97/19422

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
IPC 6	C12N15/31 A61K39/09	C12N5/18 G01N33/569
C12N1/21 G01N33/68	C07K14/315	C12Q1/68
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC 6 C12N C07K C12Q A61K G01N		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 06732 A (UNIV ROCKEFELLER ;MASURE H ROBERT (US); PEARCE BARBARA J (US); TUO) 9 March 1995 SEQ ID nos. 3 and 4 see claims 1-52	1-21
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
6 May 1998		18. 08. 1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer  HORNIG H.

Form PCT/ISA/210 (second sheet) (July 1992)

## INTERNATIONAL SEARCH REPORT

Intern: Application No

PCT/US 97/19422

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 16082 A (ASTRA AB ;BALGANESH TANJORE SOUNDARARAJA (IN); TOWN CHRISTINE MARY) 30 May 1996 SEQ ID nos. 5 and 6 see claims 1-26 ---	1-15
A	WO 95 31548 A (UAB RESEARCH FOUNDATION ;YOTHER JANET (US); DILLARD JOSEPH P (US)) 23 November 1995 see the whole document ---	1-21
A	WO 95 14712 A (RES CORP TECHNOLOGIES INC) 1 June 1995 see the whole document ---	1-21
A	WO 96 05859 A (AMERICAN CYANAMID CO) 29 February 1996 see abstract ---	1-21
A	WO 93 10238 A (US HEALTH) 27 May 1993 see the whole document ---	1-21
A	EP 0 687 688 A (UNIV OVIEDO ;UNIV LEICESTER (GB)) 20 December 1995 see abstract ---	1-21
A	EP 0 622 081 A (UAB RESEARCH FOUNDATION) 2 November 1994 see the whole document ---	1-21
A	B.J. PEARCE ET AL.: "Genetic identification of exported proteins in Streptococcus pneumoniae" MOLECULAR MICROBIOL., vol. 9, no. 5, 1993, BLACKWELL, OXFORD, GB, pages 1037-1050, XP002060149 see the whole document -----	1-21

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 97/ 19422

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
  
Remark: Although claim 17 is directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see continuation-sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-21 partially (subject 1. on continuation-sheet)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

## 1. Claims: (1-21) partially

An isolated nucleic acid molecule comprising a polynucleotide having a nucleotide sequence at least 95% identical to a sequence from the group consisting of of: (a) a nucleotide sequence SEQ ID no.1 encoding the amino acid sequence of the polypeptide SEQ ID no.2 shown in Table 1; or (b) a nucleotide sequence complementary to said nucleotide sequence in (a); an isolated nucleic acid molecule comprising a polynucleotide which hybridizes under stringent conditions to a polynucleotide having a nucleotide sequence identical to a nucleotide sequence in (a) or (b), wherein said polynucleotide which hybridizes does not hybridize under stringent hybridization conditions to a polynucleotide having a nucleotide sequence consisting of only A or of only T residues; an isolated nucleic acid molecule comprising a polynucleotide which encodes the amino acid sequence or an epitope-bearing portion of a polypeptide having an amino acid sequence of SEQ ID no.2 in (a); said epitope-bearing portion of a said polypeptide has an amino acid sequence listed in Table 2; a method of making a vector using said isolated nucleic acid molecule; said recombinant vector; a method of making a recombinant host cell using said vector; said recombinant host cell; a method of producing said polypeptide; said polypeptide; an isolated antibody that binds to said polypeptide; a hybridoma which produces said antibody; a vaccine comprising said polypeptide selected from SEQ ID no.2 in Table 1, or a fragment thereof; a method of preventing or attenuating an infection caused by a member of Streptococcus genus in animal using said polypeptide; a method for detecting Streptococcus nucleic acid sequences using the above-described nucleic acid probe; a kit for detecting Streptococcus antibodies in a biological sample using said polypeptide sequence;

## 2-113. Claims: (1-21) partially

-Idem as subject 1 but limited to the sequences having SEQ ID nos. 3 to 226. (Invention 2 is limited to SEQ ID nos. 3 and 4; Invention 3 is limited to SEQ ID nos. 5 and 6; .... ..... Invention 113 is limited to SEQ ID nos. 225 and 226).

For the sake of conciseness, the first group is explicitly defined, the other groups are defined by analogy hereto.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Application No

PCT/US 97/19422

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Form PCT/ISA/210 (patent family annex) (July 1992)

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 97/19422

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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